SPECIAL CORRESPONDENT AT THE JENA UNIVERSITY.—*See page 133.*

THE PRACTICAL TEACHER

DR. W. G. McNAUGHT

CONTENTS

OF THE

SEPTEMBER NUMBER.

	PAGE
FULL NOTES OF A LESSON ON CLIMBING AND RUNNING STEMS. By PROFESSOR J. R. GREEN, Sc.D., F.R.S.	129
CIRCULAR LETTER 351, S. & A.	130
GERMAN PRIMARY SCHOOLS. By STEWART A. ROBERTSON, M.A.	130
CLASS LESSONS IN DOMESTIC ECONOMY. By ETHEL R. LUSH	131
OUR SPECIAL CORRESPONDENT AT JENA	133
NEW COMPOSITION STORIES.—STANDARD V, AND FIRST YEAR P.T.'S.	137
VISITS OF INSTRUCTION. III.—THE 'DAILY CHRONICLE' PAPER MILLS, SITTINGBOURNE	139
COURSE 'B' IN ARITHMETIC. By B. ELDERKIN	141
'COMPOSITION THEMES AND MORAL TRAINING'	142
NEW PROBLEMS IN ARITHMETIC. By T. B. ELLERY, F.R.G.S.	143
OUR 1897 CERTIFICATE CLASS. By J. C. HOROBIN, M.A. ...	145
THE INSPECTOR'S NOTE BOOK. By an INSPECTOR OF SCHOOLS	149
ELEMENTARY LESSONS IN AGRICULTURAL ZOOLOGY. By PROFESSOR J. R. GREEN, Sc.D., F.R.S., and F. L. GREEN ...	150
MODEL ANSWERS TO QUEEN'S SCHOLARSHIP QUESTIONS	152
FAGIN, THE THIEF-TRAINER. A NEGLECTED ASPECT OF EDUCATION. By JOHN ADAMS, M.A., B.Sc.	155
A RECENT INSPECTION	157
OUR SCOTCH LETTER	160
NOTES AND NOTIONS. By T. B. ELLERY	163
EDUCATION ABROAD	165
QUERY COLUMN	166
THE SCOTCH CERTIFICATE EXAMINATION SYLLABUS ...	167
REPORT ON SECONDARY EDUCATION IN SCOTLAND ...	168
OUR PUPIL TEACHER'S AND SCHOLARSHIP COURSE. By ARTHUR T. FLUX	169
RESULTS OF THE PUPIL TEACHERS' PRIZE COMPETITIONS	175
EDUCATION DEPARTMENT.—THE VISION OF CHILDREN. By WALKER OVEREND, M.A., M.D., B.Sc.	176
MATHEMATICS. By G. A. BAXANDALL...	177
NOTES ON THEORETICAL MECHANICS. By F. CASTLE, M.I.M.E.	179
MODEL ANSWERS TO HONOURS STAGE, INORGANIC CHEMISTRY, 1896	181
SCIENCE NOTES	183
MAGNETISM AND ELECTRICITY. By EDWIN EDSER, A.R.C.S.	183
REVIEWS	184
PUBLICATIONS RECEIVED	186

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THE

PRACTICAL TEACHER

A MONTHLY EDUCATIONAL JOURNAL.

'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

VOL. XVII. No. 3. SEPTEMBER, 1896. PRICE, 6D. POST FREE, 8D.

FULL NOTES OF A LESSON ON CLIMBING AND RUNNING STEMS.

BY PROFESSOR J. R. GREEN, SC.D., F.R.S.,

Examiner in Botany to the University of London, Late Examiner in Botany to the University of Cambridge.

THE SUPPLEMENT PRESENTED WITH THIS NUMBER.

Time—40 *Minutes.*

APPARATUS.—There should be dug up and brought to class as complete a plant as possible of (1) The Common Blue Garden Flag or the wild Yellow Flag that grows in marshy places; (2) the Common Garden Strawberry, or the wild Wood Strawberry; (3) the Common Sedge which grows in wet and marshy places, or the Couch Grass; and (4) the Field or Garden Hop. To these should be added (5) a branch of the Garden Clematis (large-flowered, white or purple), or the wild Virgin's Bower (small-flowered Clematis); (6) a complete plant of Sweet Pea or Field Pea; (7) a branch of a Vine; (8) a branch of the White Bryony; (9) a branch of the self-clinging Virginia Creeper.

With specimens of these plants figured in the sheet there may be compared (i.) a branch of Honeysuckle; (ii.) a branch of Scarlet Runner; (iii.) a branch of Ivy; (iv.) a piece of Cucumber or Vegetable Marrow stem with tendrils.

INTRODUCTION.

I. STEMS ARE USUALLY UPRIGHT. *Experiment.*—Let a glass be filled with water and the top be covered with a piece of white muslin. Sprinkle the muslin with seeds of the White Mustard. Cover the whole with a bell jar and place it in the dark. After two or three days the young stems will be found growing straight up and the young roots growing straight down into the water.

Comparison.—Elicit from the children examples of upright growing plants which need no tying to sticks or other supports, *e.g.* Trees, Hyacinths, Scarlet Geraniums.

II. SOME STEMS HAVE A TENDENCY TO CURVE. Every gardener knows that many plants, especially if they are very tall, are too weak to support themselves, and have to be tied to sticks or nailed back to a wall. Examples: tall tulips, carnations, chrysanthemums. Whether they remain upright or not depends partly on their height, partly on the firmness of their texture. If no sticks were put in for them, what would happen? They would either break with the force of the wind or would lie prostrate on the ground. Other causes of the curving of the stem are the action of a lateral light, of gravity, and of mechanical disturbance.

RUNNING AND CLIMBING STEMS.

I. STEMS MAY TRAIL OR RUN ALONG THE GROUND. We have seen that this sometimes results from weakness. There are other forms which never grow vertically upwards, but always in a direction parallel to the surface of the ground. Let us compare our Flag, Strawberry, and Couch Grass (Figs. 1, 2, 3). In the Flag we see that running partly along the surface of the ground and partly beneath it, there is a thickened knotty body which at first sight we might take for a root. But it is not a root. From its under side are given off roots, and from its upper side leaves and shoots. It is therefore a stem. This kind of partly underground creeping stem is called a Rhizome. *Other Examples:* Solomon's Seal, Bistort (Polygonum).

Our Sedge and Couch Grass are very like the Flag in appearance. Let us notice the differences between them. First they are much more slender than the Flag; secondly, they grow to a greater length; thirdly, they are underground all through their course. They are true *creeping stems.* The Couch Grass is a great enemy to the farmer, for when its stem is cut in pieces each of the pieces gives off a leaf bud and roots, and becomes a fresh plant. The Sand Sedge is a very useful plant. It spreads through the sand of the seashore, binding it together and preventing its being washed away by the waves.

Now let us look at our Strawberry. From the base of the root is sent off a long slender prostrate branch which produces at its extremity leaves and roots. This branch is called a *runner.* Each runner, when detached, makes a new plant. Now we will compare with the Strawberry a House Leek. What are the points of difference? It is shorter, it is thicker, and the leaves it gives off grow in tufts. This form of runner is called an *offset.* Another example may be found in the garden Auricula.

A little like runners are *Stolons* and *Suckers.* A very familiar example of the Stolon is seen in currants and gooseberries. A branch given off above the surface of the ground curves down to it, and when it reaches a moist spot sends off rootlets downwards and a stem into the air, thus forming a new plant. Gardeners imitate this process when they *layer* pinks and carnations. Suckers pursue just the opposite course to Stolons. Good examples are the Rose, Raspberry, and Mint. A branch arises from the stem below the surface of the earth, proceeds horizontally for a time, giving off rootlets in its course, and then turns upwards into the air, forming a separate plant ultimately.

II. STEMS MAY SUPPORT THEMSELVES BY TWINING ROUND OTHER BODIES. Let us now look at our Hop, Scarlet Runner, and Bryony. They are all alike in one respect. They all support themselves by twisting round other bodies in a spiral manner. What are the points of difference between them? Let us notice the direction in which this twisting takes place. In the Hop it is from left to right, a right-handed spiral like the hands of a watch lying face upwards. 'When the shoot of a hop rises from the ground, the two or three first formed joints or internodes are straight and remain stationary; but the next formed, whilst very young, may be seen to bend to one side and to travel slowly round towards all points of the compass, moving like the hands of a watch with the

☞ Subscribers who do not receive the Coloured Supplement Presented with this Number are asked to promptly communicate with us, and to send at the same time name and address of Bookseller or Newsagent through whom the Magazine is obtained.

sun. The revolving movement continues as long as the plant continues to grow, but each separate internode, as it becomes old, ceases to move' (Darwin). In the Scarlet Runner the twining is from right to left like a corkscrew. In the White Bryony it is irregular, going first in one direction, then in another.

III. STEMS MAY CLIMB BY MEANS OF ROOTS, HOOKS, LEAF-STALKS, OR TENDRILS. Let us now look at our Ivy. We know that it is a climber, for we have often seen it covering old walls. How is its climbing done? Roots are generally underground, but the stem of the ivy gives forth little brown roots into the air (aerial roots) by which it clings to the surface of the wall so tightly that when you pull a piece off, the roots often break away from the stem, remaining attached to the wall.

How does our Jack-run-the-edge or Goosegrass climb? Its stem and leaves are beset with backward-directed hooks, which are caught up in the surrounding vegetation, thus binding the plant to the growth of the hedgerow.

Now let us look at our Clematis, Virgin's Bower, and Climbing Nasturtium. They may be called leaf climbers, for their leaf-stalks clasp the bodies to which they are attached.

Our Sweet Pea, Field Pea, Vine, White Bryony, and Self-clinging Virginia Creepers are examples of another class of climbers. They attach themselves to neighbouring bodies by thread-like organs called tendrils which are very sensitive to touch, and which curl round an object such as a twig when their sensitive side comes into contact with it. In the Vine some of the flower-stalks are thus modified; in the Sweet Pea and Field Pea, leaflets; in the White Bryony and the Virginia Creeper, branches.

Tendrils are highly sensitive. Those of the Common Pea move in ellipses; a single light touch on the lower surface near the tip will make them bend quickly. The long thick tendrils of the Vine are much less active, but move from side to side or in narrow ellipses. Darwin often went to watch a 'Bryony growing in an exposed hedge, with its tendrils attached to the surrounding bushes, and as the thick and thin branches were tossed to and fro by the wind, the tendrils, had they not been excessively elastic, would instantly have been torn off and the plant thrown prostrate. But as it was the Bryony safely rode out the gale.' In the Bryony the whole tendril —excepting the base and the tip—is continuously curved, bending in succession to each point of the compass. If a line of paint be drawn on the surface of a thick tendril which chances to be convex at the time, it will first become lateral, then concave, then lateral, and lastly convex again. Virginian creepers climb by means of tendrils. Those of the small-leaved kind have at the end adhesive discs, by which they adhere to walls or other surfaces.

SUMMARY.

1. Stems when growing without any interference from external forces generally are upright.
2. Sometimes when weak, or when acted upon by various causes, they tend to curve and to take up different positions accordingly.
3. Some do not ever grow in an upright direction, but always more or less in a direction parallel with the surface of the ground. Such are rhizomes, runners, stolons, and suckers.
4. Some stems which are too weak to support themselves in an upright position climb round other stems or different supports. Such are the Hop and the Convolvulus. Many plants climb by twining stems, or petioles, or special sensitive organs called tendrils; others scramble up through bushes by means of prickles.

CIRCULAR LETTER 251. S. & A.

Science and Art Department,
South Kensington,
24th July 1896.

SIR,—Referring to my circular letter of the 27th June (No. 306) on the subject of attendance grants in Science and Art Schools, I am directed to inform you that the Lords of the Committee of Council on Education having received representations from the committees of several schools as to the difficulties of introducing the new system at such short notice after arrangements for the coming session have been made, have decided to allow the committee of any school the option of continuing to work and receive grants under the rules of the Directory for 1895–6.

This option must be notified before the 1st October.

The syllabuses of the courses of instruction given in the Directory for 1896–7 must, however, be followed in all cases.

I have the honour to be, sir,
Your obedient Servant,
J. F. D. DONNELLY.

GERMAN PRIMARY SCHOOLS.

BY STEWART A. ROBERTSON, M.A.
English Master, Stirling High School.

GERMANY has long exported generalisations to an attentive world, but there is no land concerning which the making of general statements is less safe. This is true in all matters, but especially is it true concerning education. Educational systems, plans, methods, and subjects differ greatly in the various states that combine to form the German Empire. They differ as the people do, for as you cannot more easily rouse to anger a Würtemburger, or even a Hamburger, than by calling him a Prussian, so an assertion concerning the education of Bavaria might have no relevance to the state of affairs in Brandenburg or Westphahlia. Yet all the various governments are alike in the zeal with which they control education, and the energy with which they meet its claims. If one were to particularise, it might be said that Bavaria must needs advance considerably before she can claim to be in line with Thuringia or Brunswick.

Control is the word which arises naturally in the mind on thinking of the German school system. For in the primary schools (*Volkschulen*) everything is arranged, ordered, and adjusted in an infinity of detail, and with an almost military regularity of treatment. This is another proof that primacy in educational theory is not incompatible with the most resolute exercise of discipline and arrangement. The very ideal is largely a military one, and it is not without a view to the three years' compulsory service that gymnastics occupy so large a place in school life. In training colleges, for instance, as much time is spent on gymnastics as on arithmetic.

All German schools give religious instruction. The theory of their position has been put thus:—'To the traditional question, whether the State or the Church is the true school authority, we reply that the choice is not complete, for there is a third position, and that the only true one. The true school authority is a union of families of the same religious belief, combined by a mutual interest in the education of their children.' Thus no school is purely secular. In large towns there are schools for different denominations. But in country districts the doors of all schools are open to Catholics, Jews, and Protestants of either confession, and religious instruction is given according to the religious complexion of the district, Lutheran, Calvinistic, or Catholic. Dissenters from the faith of their neighbours, if not numerous enough to constitute a class which their pastor may come to teach, are exempted from attendance on religious instruction on condition that the parents show that the religious instruction of their children is attended to at home. In studying the programmes of religious instruction one cannot but feel how easily the religious instruction slips into political teaching. This is very marked in Prussia, where the effort seems unceasing to arm the young mind against the allurements of socialism, under whose spell the workmen of that land bind themselves so strongly. In Anhalt, and it may be elsewhere, there is a provision that when the instruction in church of candidates for confirmation begins, their religious instruction in school should cease. But everywhere in Germany there is a strong feeling, surviving from Reformation times, that the teacher should be somewhat of a cleric. In the *Volkschulgesetz* of Gotha, it is suggested to the teacher that he may add to his income by becoming choir leader, session clerk, and clerk to the parish council. Salaries in country schools are small in comparison with those of our land, but they are raised regularly at intervals of five years' service, and there is, in most states, a pension system.

In remote country districts there is combination of the duties of the *Herr Pastor* and the *Herr Lehrer*, which is very interesting. My first experience of such was in the Harz. We had gone up the wonderful valley of the Bode, whose gloomy cliffs might have been Doré's models for his precipices of the Inferno, and had passed the Hexentanzplatz, where the witches gathered before their wilder revels on the Brocken, and we had come at last to Treseburg. A little village of two

BRITISH MUSEUM

hundred souls, it lies amidst its hills close set with firs, like, to borrow Heine's simile, a moss rose in its encircling cup of green. It is remote from an official pastor, but in the quiet of the early sabbath morning the bell of the schoolhouse, scarce louder than the rushing of the brook which bounded the playground, summoned all who wished to attend morning service. The fresh voices of the children sent the confident notes of *'Ein' feste Burg'* out at the open windows to mingle with the murmur of the stream, and the *Herr Lehrer* passed in frequent and rapid transition from the organ-stool to the reading-desk, from which he read to his small congregation the appointed prayers of the church, and the sermon for the day, from a collection compiled by the authorities. Are there not some difficulties in our own land that might disappear in such conjunction of functions, especially if they were discharged with the keen interest of the *Herr Lehrer* of Treseburg, whose three weeks of holidays, he said, left him always more eager for his work, and more certain that he was wiser as well as happier in being one of those to whom the perfumes of the pine are sweeter than the lindens of Berlin.

School buildings, even in country districts, are good, and Government regulations are concerned much more fully with their condition than are our British requirements. Little is left to local possibilities of error or to the direct control of the local school councils. Brunswick, for instance, issues decrees concerning the number of windows in each schoolroom, their position in relation to the door, and their height from the floor, as well as concerning the manner of outlook from the school, whose site is recommended to be one which affords a view. For to many Germans the height of happiness is to reach some spot commanding a wide prospect and there to sit. And, in allegory, is the same true of the German mind. It is ever seeking to make prospects in education, and thus leads to a production of educational literature which to the eyes of a Briton is marvellous in its amount. School books are of course many and varied, though all require to be sanctioned for use by the educational authorities; but more numerous and infinitely more varied are the *Abhandlungen* on every conceivable point of educational theory and practice. There have been more books published in Germany within the last ten years on Herbartian doctrines alone than in England in the same time on the whole range of pædagogical subjects. There is a habit of discussion on educational matters that is very rare with us. The system encourages this. Inspectors of schools, who are chosen from 'learned and experienced teachers,' are required to hold a conference with the teachers of their districts at least once a month, as they again are summoned once a year to confer with the supreme educational authorities of the state. That portion of their work is perhaps equally valuable with their other duties of seeing that the number of scholars under each teacher does not exceed the prescribed limit—varying from 40 in some states to 60 in others—and that the precisely tabulated portions of work for each month and even each week are closely adhered to.

The subjects of the *Volkschulen* are the usual primary subjects, with nature-knowledge, natural history, and general notions of geology. To these there is added in some districts gardening in a garden attached to the school. Singing is made much more of an incidental subject than in those schools of our land which frown upon its escaping from its one hour a week.

Candidates for the profession of teacher enter the training colleges, after examination, at the age of sixteen, and spend there three years. In their curriculum—I take Potsdam as an instance—one may note the large amount of time given to practical teaching, as much sometimes as twelve hours a week, the addition to religious instruction of lectures on the history of the Christian Church, and the lessons on swimming. A German student once said to me, 'A man who does not swim is so much less a man,' and most German gymnasia accept the principle. The Education Department assumes the responsibility of finding a situation for those who leave the training college, and continues to watch over them when placed. To such an extent does it carry its paternalism that, if a teacher wishes to marry, he must submit the name of the lady he has chosen, with specifications as to her respectability, to the authorities of the state, and await from them the permit that is to make him happy.

CLASS LESSONS IN DOMESTIC ECONOMY.

BY ETHEL R. LUSH.

Author of 'Chats with Children on Domestic Economy,' Head Mistress of the Ipswich Higher Grade Girls' School, and Organising Mistress to the Ipswich School Board.

STANDARD III.

Lesson III.—SILK.

Apparatus.—Silkworms and cocoons, pieces of silk, satin, velvet, plush, ribbon, etc., two short brass rods, a basin of hot water, and a piece of calico, microscope and slide of silk-fibres.

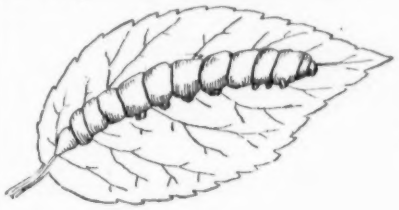
It will doubtless seem strange to you that the most beautiful of clothing materials, viz. silk, should be produced by a caterpillar.

I have in my hand a box containing a few of these silkworms, as they are called. Notice how similar the silkworm is to the caterpillars you find in the garden. Like them it has six short legs in front, and some thick stumpy ones behind. In length it is about two inches, and its skin is smooth and creamy.

When the silkworm is hatched from the egg it is a tiny black grub, scarcely a quarter of an inch long. It at once begins to feed upon the mulberry leaves, which form its chief food, and rapidly grows larger and larger until it actually bursts from its skin. Then it goes on eating and growing until a second time it casts its out-grown skin. This continues until the silkworm has had four new skins, by which time it is a full-grown caterpillar, like those you see before you.

Presently the silkworm appears to fall sick and ceases to eat; then it sends out from two small holes in its head, under its jaws, a sticky, yellow, gum-like substance, which hardens on exposure to the air, and forms a fine silken thread, from which the silkworm makes a soft cosy bed.

A filmy loose web is first formed, and this serves as an outer covering, and by degrees the web is thickened until the worm is quite concealed, and the cocoon becomes an oval ball not quite as large as a small walnut.



SILKWORM.

COCOON.

You must not imagine, however, that the worm remains unchanged. We will open a cocoon, and you will see in the middle a hard shell, bearing still some slight resemblance to the caterpillar, and known now as a chrysalis.

If the cocoons were left undisturbed, we should find at the end of ten or twelve days that a pretty moth with yellowish wings had eaten its way from each one.

Unfortunately, in doing this, the moth spoils its silken web, and for this reason silkworm rearers kill the worm by throwing the cocoons into boiling water or baking them in hot ovens.

The climate of England is not sufficiently warm for rearing silk-worms; this is done in the warmer countries in the south of Europe, also in Egypt, China, Australia, and parts of America.

The Chinese were the first to manufacture silk, and, according to the custom of the nation, the source of silk was kept a profound secret, so much so, that for a long time Europeans regarded it as a plant fibre. Eventually, so the story goes, some travellers discovered that the beautiful silken threads were produced by caterpillars, and a number of silkworms' eggs were brought away from China concealed in a hollow cane.

The first step in the manufacture of silk is that of taking it from the cocoon. This is an extremely delicate process, and is performed by girls who throw the cocoons into pans of

sun. The revolving movement continues as long as the plant continues to grow, but each separate internode, as it becomes old, ceases to move' (Darwin). In the Scarlet Runner the twining is from right to left like a corkscrew. In the White Bryony it is irregular, going first in one direction, then in another.

III. STEMS MAY CLIMB BY MEANS OF ROOTS, HOOKS, LEAF-STALKS, OR TENDRILS. Let us now look at our Ivy. We know that it is a climber, for we have often seen it covering old walls. How is its climbing done? Roots are generally underground, but the stem of the ivy gives forth little brown roots into the air (aerial roots) by which it clings to the surface of the wall so tightly that when you pull a piece off, the roots often break away from the stem, remaining attached to the wall.

How does our Jack-run-the-edge or Goosegrass climb? Its stem and leaves are beset with backward-directed hooks, which are caught up in the surrounding vegetation, thus binding the plant to the growth of the hedgerow.

Now let us look at our Clematis, Virgin's Bower, and Climbing Nasturtium. They may be called leaf climbers, for their leaf-stalks clasp the bodies to which they are attached.

Our Sweet Pea, Field Pea, Vine, White Bryony, and Self-clinging Virginia Creepers are examples of another class of climbers. They attach themselves to neighbouring bodies by thread-like organs called tendrils which are very sensitive to touch, and which curl round an object such as a twig when their sensitive side comes into contact with it. In the Vine some of the flower-stalks are thus modified; in the Sweet Pea and Field Pea, leaflets; in the White Bryony and the Virginia Creeper, branches.

Tendrils are highly sensitive. Those of the Common Pea move in ellipses; a single light touch on the lower surface near the tip will make them bend quickly. The long thick tendrils of the Vine are much less active, but move from side to side or in narrow ellipses. Darwin often went to watch a 'Bryony growing in an exposed hedge, with its tendrils attached to the surrounding bushes, and as the thick and thin branches were tossed to and fro by the wind, the tendrils, had they not been excessively elastic, would instantly have been torn off and the plant thrown prostrate. But as it was the Bryony safely rode out the gale.' In the Bryony the whole tendril —excepting the base and the tip—is continuously curved, bending in succession to each point of the compass. If a line of paint be drawn on the surface of a thick tendril which chances to be convex at the time, it will first become lateral, then concave, then lateral, and lastly convex again. Virginian creepers climb by means of tendrils. Those of the small-leaved kind have at the end adhesive discs, by which they adhere to walls or other surfaces.

SUMMARY.

1. Stems when growing without any interference from external forces generally are upright.
2. Sometimes when weak, or when acted upon by various causes, they tend to curve and to take up different positions accordingly.
3. Some do not ever grow in an upright direction, but always more or less in a direction parallel with the surface of the ground. Such are rhizomes, runners, stolons, and suckers.
4. Some stems which are too weak to support themselves in an upright position climb round other stems or different supports. Such are the Hop and the Convolvulus. Many plants climb by twining stems, or petioles, or special sensitive organs called tendrils; others scramble up through bushes by means of prickles.

CIRCULAR LETTER 251. S. & A.

Science and Art Department,
South Kensington,
24th July 1896.

SIR,—Referring to my circular letter of the 27th June (No. 306) on the subject of attendance grants in Science and Art Schools, I am directed to inform you that the Lords of the Committee of Council on Education having received representations from the committees of several schools as to the difficulties of introducing the new system at such short notice after arrangements for the coming session have been made, have decided to allow the committee of any school the option of continuing to work and receive grants under the rules of the Directory for 1895–6.

This option must be notified before the 1st October.

The syllabuses of the courses of instruction given in the Directory for 1896–7 must, however, be followed in all cases.

I have the honour to be, sir,
Your obedient Servant,
J. F. D. DONNELLY.

GERMAN PRIMARY SCHOOLS.

BY STEWART A. ROBERTSON, M.A.
English Master, Stirling High School.

GERMANY has long exported generalisations to an attentive world, but there is no land concerning which the making of general statements is less safe. This is true in all matters, but especially is it true concerning education. Educational systems, plans, methods, and subjects differ greatly in the various states that combine to form the German Empire. They differ as the people do, for as you cannot more easily rouse to anger a Würtemburger, or even a Hamburger, than by calling him a Prussian, so an assertion concerning the education of Bavaria might have no relevance to the state of affairs in Brandenburg or Westphahlia. Yet all the various governments are alike in the zeal with which they control education, and the energy with which they meet its claims. If one were to particularise, it might be said that Bavaria must needs advance considerably before she can claim to be in line with Thuringia or Brunswick.

Control is the word which arises naturally in the mind on thinking of the German school system. For in the primary schools (*Volkschulen*) everything is arranged, ordered, and adjusted in an infinity of detail, and with an almost military regularity of treatment. This is another proof that primacy in educational theory is not incompatible with the most resolute exercise of discipline and arrangement. The very ideal is largely a military one, and it is not without a view to the three years' compulsory service that gymnastics occupy so large a place in school life. In training colleges, for instance, as much time is spent on gymnastics as on arithmetic.

All German schools give religious instruction. The theory of their position has been put thus:—'To the traditional question, whether the State or the Church is the true school authority, we reply that the choice is not complete, for there is a third position, and that the only true one. The true school authority is a union of families of the same religious belief, combined by a mutual interest in the education of their children.' Thus no school is purely secular. In large towns there are schools for different denominations. But in country districts the doors of all schools are open to Catholics, Jews, and Protestants of either confession, and religious instruction is given according to the religious complexion of the district, Lutheran, Calvinistic, or Catholic. Dissenters from the faith of their neighbours, if not numerous enough to constitute a class which their pastor may come to teach, are exempted from attendance on religious instruction on condition that the parents show that the religious instruction of their children is attended to at home. In studying the programmes of religious instruction one cannot but feel how easily the religious instruction slips into political teaching. This is very marked in Prussia, where the effort seems unceasing to arm the young mind against the allurements of socialism, under whose spell the workmen of that land bind themselves so strongly. In Anhalt, and it may be elsewhere, there is a provision that when the instruction in church of candidates for confirmation begins, their religious instruction in school should cease. But everywhere in Germany there is a strong feeling, surviving from Reformation times, that the teacher should be somewhat of a cleric. In the *Volkschulgesetz* of Gotha, it is suggested to the teacher that he may add to his income by becoming choir leader, session clerk, and clerk to the parish council. Salaries in country schools are small in comparison with those of our land, but they are raised regularly at intervals of five years' service, and there is, in most states, a pension system.

In remote country districts there is combination of the duties of the *Herr Pastor* and the *Herr Lehrer*, which is very interesting. My first experience of such was in the Harz. We had gone up the wonderful valley of the Bode, whose gloomy cliffs might have been Doré's models for his precipices of the Inferno, and had passed the Hexentanzplatz, where the witches gathered before their wilder revels on the Brocken, and we had come at last to Treseburg. A little village of two

BRITISH MUSEUM

hundred souls, it lies amidst its hills close set with firs, like, to borrow Heine's simile, a moss rose in its encircling cup of green. It is remote from an official pastor, but in the quiet of the early sabbath morning the bell of the schoolhouse, scarce louder than the rushing of the brook which bounded the playground, summoned all who wished to attend morning service. The fresh voices of the children sent the confident notes of '*Ein' feste Burg*' out at the open windows to mingle with the murmur of the stream, and the *Herr Lehrer* passed in frequent and rapid transition from the organ-stool to the reading-desk, from which he read to his small congregation the appointed prayers of the church, and the sermon for the day, from a collection compiled by the authorities. Are there not some difficulties in our own land that might disappear in such conjunction of functions, especially if they were discharged with the keen interest of the *Herr Lehrer* of Treseburg, whose three weeks of holidays, he said, left him always more eager for his work, and more certain that he was wiser as well as happier in being one of those to whom the perfumes of the pine are sweeter than the lindens of Berlin.

School buildings, even in country districts, are good, and Government regulations are concerned much more fully with their condition than are our British requirements. Little is left to local possibilities of error or to the direct control of the local school councils. Brunswick, for instance, issues decrees concerning the number of windows in each schoolroom, their position in relation to the door, and their height from the floor, as well as concerning the manner of outlook from the school, whose site is recommended to be one which affords a view. For to many Germans the height of happiness is to reach some spot commanding a wide prospect and there to sit. And, in allegory, is the same true of the German mind. It is ever seeking to make prospects in education, and thus leads to a production of educational literature which to the eyes of a Briton is marvellous in its amount. School books are of course many and varied, though all require to be sanctioned for use by the educational authorities; but more numerous and infinitely more varied are the *Abhandlungen* on every conceivable point of educational theory and practice. There have been more books published in Germany within the last ten years on Herbartian doctrines alone than in England in the same time on the whole range of pædagogical subjects. There is a habit of discussion on educational matters that is very rare with us. The system encourages this. Inspectors of schools, who are chosen from 'learned and experienced teachers,' are required to hold a conference with the teachers of their districts at least once a month, as they again are summoned once a year to confer with the supreme educational authorities of the state. That portion of their work is perhaps equally valuable with their other duties of seeing that the number of scholars under each teacher does not exceed the prescribed limit—varying from 40 in some states to 60 in others—and that the precisely tabulated portions of work for each month and even each week are closely adhered to.

The subjects of the *Volkschulen* are the usual primary subjects, with nature-knowledge, natural history, and general notions of geology. To these there is added in some districts gardening in a garden attached to the school. Singing is made much more of an incidental subject than in those schools of our land which frown upon its escaping from its one hour a week.

Candidates for the profession of teacher enter the training colleges, after examination, at the age of sixteen, and spend there three years. In their curriculum—I take Potsdam as an instance—one may note the large amount of time given to practical teaching, as much sometimes as twelve hours a week, the addition to religious instruction of lectures on the history of the Christian Church, and the lessons on swimming. A German student once said to me, 'A man who does not swim is so much less a man,' and most German gymnasia accept the principle. The Education Department assumes the responsibility of finding a situation for those who leave the training college, and continues to watch over them when placed. To such an extent does it carry its paternalism that, if a teacher wishes to marry, he must submit the name of the lady he has chosen, with specifications as to her respectability, to the authorities of the state, and await from them the permit that is to make him happy.

CLASS LESSONS IN DOMESTIC ECONOMY.

BY ETHEL R. LUSH.

Author of 'Chats with Children on Domestic Economy,' Head Mistress of the Ipswich Higher Grade Girls' School, and Organising Mistress to the Ipswich School Board.

STANDARD III.

Lesson III.—SILK.

Apparatus.—Silkworms and cocoons, pieces of silk, satin, velvet, plush, ribbon, etc., two short brass rods, a basin of hot water, and a piece of calico, microscope and slide of silk-fibres.

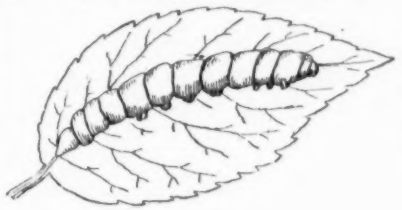
It will doubtless seem strange to you that the most beautiful of clothing materials, viz. silk, should be produced by a caterpillar.

I have in my hand a box containing a few of these silkworms, as they are called. Notice how similar the silkworm is to the caterpillars you find in the garden. Like them it has six short legs in front, and some thick stumpy ones behind. In length it is about two inches, and its skin is smooth and creamy.

When the silkworm is hatched from the egg it is a tiny black grub, scarcely a quarter of an inch long. It at once begins to feed upon the mulberry leaves, which form its chief food, and rapidly grows larger and larger until it actually bursts from its skin. Then it goes on eating and growing until a second time it casts its out-grown skin. This continues until the silkworm has had four new skins, by which time it is a full-grown caterpillar, like those you see before you.

Presently the silkworm appears to fall sick and ceases to eat; then it sends out from two small holes in its head, under its jaws, a sticky, yellow, gum-like substance, which hardens on exposure to the air, and forms a fine silken thread, from which the silkworm makes a soft cosy bed.

A filmy loose web is first formed, and this serves as an outer covering, and by degrees the web is thickened until the worm is quite concealed, and the cocoon becomes an oval ball not quite as large as a small walnut.



SILKWORM.

COCOON.

You must not imagine, however, that the worm remains unchanged. We will open a cocoon, and you will see in the middle a hard shell, bearing still some slight resemblance to the caterpillar, and known now as a chrysalis.

If the cocoons were left undisturbed, we should find at the end of ten or twelve days that a pretty moth with yellowish wings had eaten its way from each one.

Unfortunately, in doing this, the moth spoils its silken web, and for this reason silkworm rearers kill the worm by throwing the cocoons into boiling water or baking them in hot ovens.

The climate of England is not sufficiently warm for rearing silk-worms; this is done in the warmer countries in the south of Europe, also in Egypt, China, Australia, and parts of America.

The Chinese were the first to manufacture silk, and, according to the custom of the nation, the source of silk was kept a profound secret, so much so, that for a long time Europeans regarded it as a plant fibre. Eventually, so the story goes, some travellers discovered that the beautiful silken threads were produced by caterpillars, and a number of silkworms' eggs were brought away from China concealed in a hollow cane.

The first step in the manufacture of silk is that of taking it from the cocoon. This is an extremely delicate process, and is performed by girls who throw the cocoons into pans of

water. Being light they float, and the girls catch hold of the loose floating ends of silk, fasten them to reeling machines near by, and the contents of the cocoons are speedily wound off without a break.

The silk is next made up into hanks, and in this form is known as *raw silk*.

CHRYSALIS IN COCOON.

HANK OF SILK.

REEL OF SILK.

The length of thread in a cocoon varies from 300 to 500 yards, and it takes 3,000 cocoons to yield one pound of silk. These figures will furnish some idea of the enormous number of silkworms that are reared to supply the great demand for silk goods.

Raw silk, like the raw wool you heard of in a previous lesson, must be spun into a strong thread, woven in a loom, and finally dyed and finished.

Silk owes much of its value to the readiness with which it takes the brightest dyes, at the same time retaining its own rich lustre.

Silk-weaving was first introduced into England in the year 1688 by French weavers who had been driven from France, and who settled at Spitalfields in London. Here for the past two centuries they and their descendants have carried on the silk industry, which in our time plays such an important part in the manufactures of the country.

Coventry in Warwickshire and Norwich in Norfolk are two other towns which were noted for their silk before the larger towns of Macclesfield, Manchester, Paisley, and Glasgow took up its manufacture.

France, however, takes the first place in the manufacture of silks, and most of those used for dresses and mantles are of French make.

The wonderful Jacquard loom, which, by means of a complex system of perforated cards, is able to produce the beautiful brocades and figured silks with which we are all familiar, is a French invention.

Jacquard, the inventor, was at first illtreated, his looms being destroyed and himself exiled, but, happily, he lived to see his genius recognised and his looms generally adopted.

Very numerous are the kinds of silken materials which issue from the looms; silks, satins, and velvets form the chief, and of these there is almost endless variety.

Silks are the simple woven materials, corresponding to cloths in woollen, and calico in cotton goods.

Brocades and figured silks are woven in various designs in the Jacquard loom.

Satin has a smooth, glossy surface. Velvet has a pile, made by weaving the threads as loops over wires and afterwards cutting them.

Plushes resemble velvets but have a longer pile, and, owing to their rich surface and the lights and shadows upon it, are very beautiful materials for hangings and upholstery generally.

Crape is made from raw silk, and is gummed and twisted to give to it its distinctive appearance.

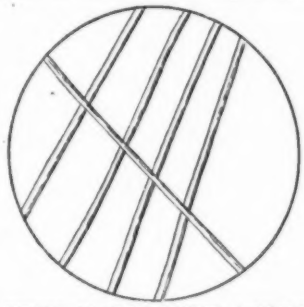
Ribbons are narrow lengths of silk which may be plainly woven, satin-faced, brocaded, or printed in endless variety. If you look at a piece of ribbon you may know by the selvedge on each side that the shuttle which carried the woof-thread to and fro had only a very short way to go before recrossing. Ribbons are made in a special kind of loom, Coventry being the chief seat of their manufacture.

Silk hosiery, which term includes silk gloves, stockings, vests, and many other articles of clothing, is the name given to the material formed of a kind of chain stitch similar to the knitting stitch. Such garments are exceedingly pleasant to wear, but are too expensive for ordinary wear except by the rich.

The qualities of silk as a clothing material now demand our attention. On the blackboard is a sketch of the slide of silk-fibres now under the microscope ready to be looked at. Observe that the jagged edge so conspicuous in a wool fibre is absent here, silk-fibres being smooth and round.

Just as the roughness of woollen material is due to the serrated edge of the fibres composing it, so is the smoothness of silk due to the glossy, even nature of the silken thread.

A silk-fibre is even finer than a wool fibre, as many as 2,000 of them lying side by side are necessary to cover an inch.



SILK FIBRES AS SEEN UNDER A MICROSCOPE.

We have seen that silk goods are smooth, glossy, soft, and beautiful. Let us now discover how far it is a conductor of heat.

Here are two brass rods immersed in a bowl of hot water, and now, of course, at the same degree of heat. We will take both rods out of the water with nippers to avoid burning our fingers, and wrap one in a piece of silk and the other in calico. After waiting a short time we shall find that the latter rod has lost most of its heat, whereas the one encased in silk is almost as hot as when it left the water. By this we know that silk is a non-conductor of heat, almost as bad a conductor, in fact, as woollen.

For this reason it an excellent material to wear next to the skin, and is particularly adapted to the needs of those persons whose skins are too sensitive to stand the friction of woollen materials.

Silk is largely used for dresses, underskirts, blouses, jackets, and mantles, and even among those who cannot afford it in large quantities, it is used for trimming and brightening dresses and hats.

The newspapers tell us that silk is to become very much cheaper, owing to the marvellous discovery of a method of making silk from wood.

The wood passes through many processes, in the course of which it is reduced to a pulp and pressed through finely perforated plates, by which means extremely fine fibres are formed. We are told that this wood-silk bears the closest resemblance to silk proper, and also possesses the desirable qualities of durability and cheapness.

SUMMARY.

Silk is produced by the silkworm, a kind of caterpillar which, when hatched from the egg, is only a quarter of an inch long. When full-grown it measures two inches. Its skin is smooth and creamy. Mulberry leaves form its food.

The silkworm weaves for itself a cocoon, in which it lies concealed for ten or twelve days. At the end of this time a moth eats its way out of the cocoon. Cocoons which are wanted for their silk are thrown into boiling water so as to kill the worm.

The silk is then reeled and formed into hanks.

Silkworms are reared in the south of Europe, China, Egypt, Australia, and parts of America.

Raw silk is spun, woven, dyed, and finished.

Silk is manufactured at Spitalfields, Coventry, Norwich, Macclesfield, Paisley, Manchester, and Glasgow.

The Jacquard loom was invented by a Frenchman, and is used in the manufacture of brocades and fancy silks.

Materials made from silks: Plain silks, satins, velvets, plushes, brocades, ribbons, crape.

Silk hosiery includes gloves, stockings, vests, etc.

A silk-fibre is about $\frac{1}{2000}$ of an inch wide, and is smooth, round, and glossy.

Silk is a bad conductor of heat, is smooth and pleasant to the touch, and if of good quality, is durable. These qualities render it suitable for underwear.

Silk is used for dresses, mantles, underskirts, blouses, linings, and trimmings.

Wood-silk is now being manufactured, and is much cheaper than silk proper.

OUR SPECIAL CORRESPONDENT AT JENA.

THE PEDAGOGICAL SEMINAR AND SUMMER COURSE.

JENA is a quaint and picturesque little town in the Thüringen, not far from Weimar. It is charmingly situated in the valley of the Saale, and it is shut in by hills, some of which are clothed with pine and beech trees. The River Saale flows through the valley, and its wooded banks afford the inhabitants of Jena peaceful and shady walks.

We are not unfamiliar with the name of Jena. This little town has its history. It recalls to us one of Napoleon's victories in 1806, which was won on the heights above the town. A single block of granite, called the Napoleon Stone, commemorates this battle. Jena is celebrated for its university, which reached its most brilliant period at the end of last century and the beginning of this, when Carl August reigned in Weimar, and gathered around him a group of Germany's greatest men. Goethe, Schiller, Herder, Fichte, and others, were associated with Jena at this period, and Froebel came here as an eager student in his early days of struggle and uncertainty, but not being able to pay his bills, he was imprisoned for debt. To the readers of this journal the chief interest of Jena to-day lies in its pedagogy. Its pedagogical seminary is, I believe, unique, and earnest seekers for pedagogical truth come from all nations to study. Our educational theories are in a transitional state; we have no definite philosophic basis upon which to build our educational methods, and we are not quite sure whether we want one. Some of us demand a science of education; some of us pretend to possess one, and some of us declare that the thing is impossible. Many of us agree that we want psychology to help us to build up our methods of teaching, but there are many successful teachers whose experience gives them a right to speak, who declare that jurisprudence or political economy would help our methods quite as well as psychology. This state of uncertainty and unrest troubles many earnest teachers, and to such Jena and its pedagogy offers consolation and help.

DR. REIN.
Photo by C. Bräunlich, Jena.

Among the students in the Pedagogical Seminar in Jena are Hungarians, Bulgarians, Armenians, Japanese, Russians, Swedes, Swiss, and a large number of Americans. The education in America owes a good deal to the stimulating influence of German thought; and Dr. Charles De Garmo, who came to Jena to study Herbartian Pedagogy some ten or twelve years ago, has helped to increase the interest in this subject in English-speaking countries.

In America especially, and in many countries of Europe, the Herbartian Pedagogy is receiving attention, and offering educationalists material for discussion, and it will therefore perhaps be useful to give some slight sketch of the pedagogy in Jena. In England we are not indifferent to the educational methods in Jena. Dr. Rein, the leader of the Herbartian School of Pedagogy, came to Oxford two years ago to give lectures on the matter, and he is at present in England after delivering a short course of lectures at the Cambridge and Edinburgh summer meetings in August.

Herbart was born in 1776, and he died in 1811. He was Professor of Philosophy at Göttingen and at Königsberg. His lectures and his writings were on pedagogical, psychological, and philosophical subjects. He held that in education theory and practice should always go together, and he writes in Königsberg: 'Amongst my duties I had the lectures on education very much at heart. But education cannot merely be taught, it must be demonstrated and practised. Long ago I conceived the idea of teaching a small number of selected boys myself for an hour daily in the presence of some young men acquainted with my pedagogy, who will afterwards attempt in my place, and under my eye, to carry on what I have begun. Gradually in this way teachers may be trained, whose methods must be perfected by mutual observation and exchange of experience.' He established a small practice school at Königsberg according to this idea, which continued to exist until 1833, and this little school was, I believe, the first school of the kind established inconnection with pedagogical lectures in a German university.

The greatest followers of the Herbartian pedagogy were Stoy and Ziller.

Stoy was Professor of Pedagogy (1815–1885) and Director of the Seminar at Jena for forty years, and Ziller in 1862 established a pedagogical seminary and practice school in connection with his work at the Leipsic University. Both of these men did much to spread Herbartian methods by the writings and by their lectures.

The Pedagogical Seminary and Practice School still exist in Jena. Dr. Rein was called to the chair of pedagogy there on the death of Stoy, and he is at present the greatest teacher of Herbartian pedagogy. Dr. Rein was born in Eisenach in 1847, and after passing through the Gymnasium there, he pursued his University studies at Jena and Heidelberg, reading theology and pedagogy. He worked under Stoy at Heidelberg, and later under Ziller at Leipsic. He took his degree in 1871. The subject of his dissertation was Herbart's 'Regierung, Unterricht und Zucht.'

As a practical teacher Dr. Rein has had considerable experience, first in Ziller's Practical School at Leipsic, then at Barmen in a Realschule, afterwards in the Seminar at Weimar, and later as principal of the Normal School at Eisenach. He came to Jena, as professor of pedagogy, in 1886, and during the last ten years his work has been there in the University and Seminar. He has written a great deal. His best-known work to English readers is 'Outlines of Pedagogy,' in which he gives a sketch of Herbart's principles. This is translated into English. He has also written a series of eight volumes, containing the subject matter, and method of treatment for each school year. The first of these, 'Das Erste Schuljahr,' is the most instructive to those who are beginning to read Herbartian literature.

Dr. Rein has edited several books, among some of the most important are Brozoska's 'Die Notwendigkeit Pädagogischer Seminare auf der Universität,' Niemeyer's 'Grundsätze der Erziehung und das Unterrichts,' and 'Am Ende der Schulreform.' At present he is engaged in preparing an encyclopedia of pedagogy.

The pedagogical work in Jena is theoretical and practical. The theoretical part is carried on in the University, where Dr. Rein lectures five hours each week. His subjects alternate. One Semester he lectures on General Didactics and Empirical Psychology, and the next on Herbart and System of Pedagogy.

The practical part of the work is carried on in the Seminar

and Practice School. The school is a simple little building on the Insel Platz. It is an ordinary house with a great rambling garden and orchard, and, according to German custom, the attic floor is inhabited, and the garden is let to a gardener who works among the roses, and the young bedding out plants, while the boys play in the orchard. Here they have a great rabbit hutch, horizontal bars, and ladders against the apple trees, and here they pass their time between the lessons, eating their lunch, feeding the rabbits, climbing the ladders, and swinging on the bars. The lower floor of the school building contains the library and the school apparatus. The upper floor has a workshop and three classrooms.

Everything is very simple, and one's first feeling is of disappointment, for one expects to find handsome buildings, and expensive apparatus, in connection with a great system of pedagogy, especially in these days when we are so apt to mistake fine schools and fine furniture for the spirit of pedagogy.

The little school in Jena, however, is not ideal in its arrangements. Her Majesty's inspectors in England would condemn its drains and its cloak rooms, and as for ventilating apparatus, it has none. However, a better time is coming; and a new school is being built, which will probably be ready next year, and then the *Praktikums* can be carried on more conveniently.

Three meetings take place every week in connection with the Seminar, and all the members are expected to attend them.

1. The *Theoreticum*.—In this meeting various members and students read reports of educational systems, dissertations, criticisms of books, etc., after which a discussion takes place directed by Dr. Rein. This meeting takes place in the university building.

2. The *Praktikum*.—This is a public lesson given by a student in the presence of the seminar members, the masters, and Dr. Rein. This takes place in the Practice School, often at seven o'clock in the morning. It is not unusual to have 40 members present at this exercise.

THE UNIVERSITY BUILDINGS, JENA.
Photo by C. Bräuntlich, Jena.

This lesson is not an isolated lesson prepared for the occasion, it is always one of a series of lessons or Method Unit which the student must work through.

3. The *Konferenz*.—This a public meeting of the seminar members in which the lesson is thoroughly criticised, and a final judgment passed upon it by Dr. Rein.

This meeting takes the place of the criticism which follows a trial lesson in one of our normal colleges, but from an English point of view the method of carrying out the criticism is peculiar.

The Konferenz takes place in the Burgkeller, which is an interesting old inn, much patronised by the students of Jena on all convivial occasions. It is a quaint old building with its red-tiled sloping roof, curious old doorway, and the church tower rising behind it. A characteristic bit of Jena student life in term time is a party of students on a social occasion in front of the Burgkeller. A great table is brought out on to the open street, and the students in their red caps sit around smoking, drinking, singing songs, and discussing their duels. One of the Jena student songs concerning this form of social life runs :—

'Wenn dem Burschen es behaget,
Setz er vor die Thür den Tisch,
Und da Kommt der Wirth gesprungen,
Da wird dann gezecht, gesungen,
Auf der strasse frei und frisch.' *

* When the students desire it,
A table is set before the door,
Then the host comes quickly,
The students sing and drink,
And everything is free and lively.

The Konferenz takes place in a panelled hall in the Burgkeller decorated with students' caps and swords. Dr. Rein presides. This meeting is partly a social occasion, in which beer mugs, according to the German custom, play an important part. The Konferenz usually begins at about half-past eight o'clock at night and it goes on until midnight, and often later. The meeting is opened, and the roll is called—for every member is expected to be present. A written account of the last meeting is read by a student, and then the student who gave the lesson reads his own criticism on his own lesson. He usually states the aim of his lesson, and points out his failures in attempting to carry it out. After this the chief critic reads a carefully prepared criticism of the lesson which forms the basis of discussion. This criticism begins with a description of the lesson, after which the following points are criticised :—

I.—The subject matter, its relation to the other subjects of instruction, and to the preceding lesson, and the following lesson in the Method Unit, also its suitability to the children.

II.—The aim of the lesson, and the manner in which the teacher stated it.

III.—The method of the presentation of the matter.

IV.—The teacher's manner, his illustrations, his use of the blackboard, and his general attitude to the class.

After this criticism is over the meeting is open for free discussion. This discussion is often scientific; and such points as the following are brought out :—

Were the children's minds really prepared to receive the new matter?

Were the formal steps rightly used, and how were they violated?

Did the children manifest interest? When and why was interest lacking?

When all the questions arising out of the criticism have been thoroughly discussed, Dr. Rein pronounces his final judgment, and the social part of the meeting begins. German student songs are sung, toasts are drunk, and clouds of smoke render the seminar members hazy and indistinct.

Women have not yet permission to enter the University classes in Jena, although many of the professors are friendly and willing to help them, especially in pursuing pedagogical studies. During the last two or three years, four or five women have worked at pedagogy in Jena, two of whom were English women. Their course was peculiar. They were not admitted to any of the lectures actually held in the University Buildings; indeed, a legend runs in Jena that an ancient inscription stands over a particular doorway of the University, which reads: 'Women, children, and dogs are strongly forbidden.' Dr. Rein directed their reading, and gave valuable private help, and they were allowed to take part in all the seminar exercises. They taught in the school, gave public criticism lessons, and once or twice read the chief criticism in the Burgkeller at the Conferences, they took part in the discussions, and wrote reports of visits to schools and criticisms of the school journey.

Some special classes bearing on pedagogy were formed for their benefit by some of the professors of the University, and the Oberlehrer of the school gave them a course on the pedagogy of Ziller. They also attended Professor Ziehen's course on physiological psychology, which was the ordinary University course; but as it was held in the Lunatic Asylum, on account of the convenience of various apparatus, and not in the University Buildings, and as no edict seemed to forbid women entering a lunatic asylum, there was no objection made to their attendance.

Three women also took part in the school journey in the

spring, when the boys, the masters, and seminar students wandered for six days in a mountainous district of Bavaria studying geography, geology, and plant life, and visiting the grave of Boniface, a monastery, and a cathedral in connection with their history studies.

It is not possible, however, for many English teachers to come out to Germany for one or two years to study methods of teaching, but if opportunities for such studies were available, we should be a broader and more intelligent body of teachers than we are. American teachers seem to manage to get constant breaks in their school life, and intervals for European travel and study. In every University town in Germany one finds a colony of American teachers who are working at special subjects or methods, which are to be introduced into their schools later.

'How can you American teachers afford to spend so much time and money in Germany?' an American teacher was asked. His reply was characteristic. 'We cannot afford not to do it.' Some day, when our faith in educational science is great enough, we too will come to Germany to study methods, and take them back to England to invigorate the life of our schools.

Summer Courses for teachers on all manner of subjects are very popular everywhere, and during the month of August Jena prepares intellectual fare for teachers of all nations. Although women are excluded from the University, they take part in the Summer Course with keen interest.

This year in the month of August 108 people invaded the quiet little town of Jena to take part in the Summer Course. It was an international gathering. Germans, Swedes, Danes, Fins, Russians, Dutch, Belgians, Hungarians, Bohemians, Austrians, Servians, Armenians, Americans, English, and one Frenchman were present. Most of the Summer Course people were engaged in educational work as University professors, gymnasium masters, science lecturers, language teachers, private teachers or elementary teachers. Dr. Rein is responsible, to a great extent, for the Summer Course, and he welcomes everybody with genial cordiality. The first assembly took place on Sunday night, August 3rd, in the Burgkeller.

VIEW OF JENA.
Photo by C. Bräunlich, Jena.

It was a curious gathering. Dr. Rein, Prof. Detmer, Dr. Erhardt, and Herr Rektor Scholz received the strangers. This year there was a particularly large number of women, among whom were some German women. It is remarkable that until this year German women have not taken part in the Jena Summer Course. The English women who were studying Pedagogy in Jena welcomed the women strangers. One was a language teacher from Finland, who was sent by her government for six months to study language teaching in other countries. Another was a bright young creature from Holland who had come to hear Dr. Rein. Another was an earnest little Russian who wanted to improve her German and learn something of Herbartian Pedagogy. These, with a few German women, two or three Americans, and a small party of English women made up the feminine element. The men were more numerous.

The company sat round long tables, according to German custom, and drank Bavarian and Lager Beer out of beer pots, and made acquaintance with each other. Dr. Rein welcomed everybody in an earnest cordial speech, and then a general introduction took place all round. Each person present rose in turn and announced his name and nationality, and the whole formality was over. Everybody was supposed to be introduced to everybody else, and friendly conversation began. Student's song books were passed round presently, and everybody joined in singing, 'Und in Jena lebt sich's bene, und in Jena lebt sich's gut.'

As so many women were present, Dr. Rein asked one of the Englishwomen who was already staying in Jena to address a few words of special welcome to them. She did this in English, and endeavoured to make the women feel at home in their unusual surroundings.

Before the company dispersed, the English speaking people were asked to sing, and they succeeded in getting through one verse of 'Home, Sweet Home' very creditably, which evoked much applause from the other nations. On Monday morning at eight o'clock the lectures began. The following is the time table :—

LECTURE PLAN.

8–9.—	Physics: Prof. Auerbach, Physical Institute.	Principles of Educational Instruction: Dr. Rein.	
9–10.—	Botany: Prof. Detmer.	German Conversation Class: Rektor Scholz.	Theory of Hand Work in Schools: Dr. Beyer.
10–11.—	Physical Demonstration: Prof. Auerbach.	Literature and Conversation Class: Dr. Erhardt.	Microscope Work in Plant Life: Prof. Detmer.
11–12.—	Physical Experiments: Prof. Schaffer.	Political Economy: Prof. Brückner.	Physiological Psychology: Prof. Ziehen.
12–1.—	School Hygiene: Prof. Gartner.		
2–4.—			Astronomy.
4–5.—	History: Dr. Steinhausen.		Practical Didactics: Rector Scholz.
5–6.—	Philosophy: Dr. Erhardt.		
6–8.—	Glass blowing.		

The most popular courses were the Pedagogical Courses and the Conversation Classes. At 8 o'clock every morning, the lecture hall was filled with Dr. Rein's students. He speaks very clearly and distinctly, and foreigners have no difficulty in following him. He discussed the ethics and psychology of education; the historical stages of culture, concentration of studies; the choice of material; the formation of the time table; and the theory of the formal steps. The Conversation Class conducted by Herr Rektor Scholz was chiefly designed to afford foreigners an opportunity of speaking the German tongue.

Simple descriptions were given of Jena, its surroundings, the battlefield, Schiller in Jena, Luther in Jena, Goethe and the Erl König, etc. These formed the material for conversation. Questions were asked on the matter, and the students were required to answer in German. They also wrote from dictation, and wrote short descriptions of Jena, and recapitulations of the lessons. In connection with this course, visits were made to the battlefield, the Schiller houses and the Schiller garden, the church where Schiller was married, and to the scenes of Goethe's Erl König. Not far from Kunitz is a marble figure of the Erl König in the Wood, and here Herr Rektor Scholz recited the poem, which the students read and paraphrased in class afterwards.

Practical Didactics was also a popular class. Herr Rektor Scholz demonstrated the educational theories laid down by Dr. Rein in his Herbartian pedagogics. The students represented a class of school children of the seventh school year. The subject of study was the 'Discovery of America.' This was dealt with in a series of history, literature, and geography lessons. The students answered the questions, gave the recapitulations, and entered the important points in their note books, just as the children were required to do in the schools. After each lesson was over, a discussion was held on points of method, which cleared up misty problems. The Literature and Conversation Class, conducted by Dr. Erhardt, was on German literature, particularly that of the Goethe and Schiller

period. In connection with this course a visit to Weimar to the Goethe and Schiller houses was undertaken. The social part of the Summer Meeting consisted of excursions to various heights on the hills around Jena, and meetings in the Burgkeller. The excursions always took place in the evening. The party assembled in a given spot at six o'clock, and, accompanied by some of the professors, made their way up the winding paths and through the woods to some interesting height. The Forst, with its Tower erected to the memory of the Jena students who fell in the war of 1870–71, was the first excursion. Here the party sat out of doors and ate a simple meal served from the primitive Forst restaurant, and enjoyed the picturesque view of Jena lying below in the valley, and the surrounding heights crowned with ruined castles or towers. The student Songs of Jena were learned in order to be sung on social occasions, and the whole party soon became familiar with the well-known words and tunes of—

'An der Saale hellem Strande
Stehen Burgen stolz und Kühn,
Ihre Dächer sind zerfallen,
Und der Wind streicht durch die Hallen,
Wolken ziehen drüben hin.' *

and

'Auf den Bergen die Burgen,
Im Thale die Saale,
Die Mädchen in Städchen,
Einst alles eure heut.' †

And from these hill tops, as the valley lay below with the Saale flowing through it, and the castles on the surrounding heights were pointed out, the foreigners soon learned to appreciate the Jena songs and the surroundings of Jena.

The Fuchsthurm is another favourite height, where a fine view was obtained, while the party sat eating their black bread, cheese, and raw ham, and drinking the famous Lichtenhainer beer.

The tower here is a remnant of the Castle of Kirchberg. The winding valleys below and the picturesque little village of Ziegenham on the upward slope, with its curious old church, afforded a pleasant outlook, and the walk back in the cool evening through the pine-woods, with the soft moon shining through the dark branches, is a memory not easily to be forgotten.

One must not forget 'Paradies' in attempting to describe Jena. This is on the left bank of the River Saale. Its double avenue of trees and peaceful shady river walks afforded opportunities of quiet, contemplative walks in the neighbourhood of the town. The town itself, with its beautiful old church and quaint old market, where the sunburnt peasant women assemble on market-days in blue check aprons and gowns, and sell butter, eggs, fruit, flowers, and vegetables; its beautiful Pulver-Thurm; its handsome avenue of trees in the Furstengraben before the University buildings; its memorial busts to Fichte, Oken, Schiller, Arndt, and other illustrious men of the University; its old-fashioned shops and crooked little streets, with uncomfortable cobble stones, is very quaint, picturesque, and unspoiled. The *Burschenschafts-Denkmal*, or Students' Monument, which stands in the Eichplatz, was erected to commemorate the efforts the German Students made in the cause of national liberty after the downfall of Napoleon. Around this monument are placed long tables in the open air, around which the Students sit to commemorate their festivals with beer-drinking and Students' Songs. The usual song of freedom on these occasions is the familiar 'Stosst an,' with its rousing chorus. It runs :—

'Stosst an, Jena soll leben, hurrah hoch!
Die Philistine sind uns gewogen meist,
Sie ahnen im Burschen was Freiheit heiest.
Frei ist der Bursch, Frei ist der Bursch.' *

The Schiller Garden, at the south side of the town, is very interesting. Here Schiller had a summer-house during the time he was a Professor in the Jena University. A large block of granite marks the spot where it stood, upon which is inscribed 'Here Schiller wrote Wallenstein.' A stone table stands in this garden, under the shade of acacia trees, and here Goethe and Schiller loved to sit in pleasant conversation. Goethe remarked to his friend Eckermann, twenty years after the death of Schiller, as he stood here: 'Here Schiller lived, and at this old stone table we have often sat in conversation, exchanging many great and good words with each other.' This inscription is put up on a tablet above the table to mark the spot. The Schiller Garden also contains a fine bust of Schiller by Dannecker.

THE BURGKELLER, JENA.

The Sundays were profitably and pleasantly spent in visits to some of the most beautiful parts of the Thüringen Wald. The first Sunday an expedition to Schwarzburg was arranged. Some sixty people took part in it. The party met in the station at Paradies, and went by train to Blankenburg. This little town is interesting in being the place where Froebel started the first Kindergarten. The house where he lived, and the school where his first Kindergarten theories were put into practice, are easily recognised, as they bear inscriptions giving the date when Froebel lived and worked in them. From Blankenburg a charming walk of two or three hours was taken through the valley by the winding Schwarza. This is one of the finest and most beautifully wooded valleys in the Thüringen. Rain came on in torrents towards evening, and the journey back on the top of coaches was not pleasant, but the whole party arrived in Jena at ten o'clock at night, safe and cheerful, if somewhat wet. The following Sunday an excursion was made to Eisenach, which is acknowledged to be the finest point in the Thüringian Forest. The Wartburg, with its memories of Ludwig, the Crusaders, Luther, and the holy Elizabeth, is one of the finest secular Norman buildings that exists. The final meeting in the Burgkeller before Dr. Rein departed for England was very interesting, and was enlivened by many German songs. Songs were demanded from the English and American people. They were not a very musical set, but they contrived to sing 'Down by the Swanee river,' 'Old John Brown,' and 'Auld Lang Syne,' with spirit and enthusiasm which the other nations applauded. The farewells at the end of the Course were sincere in their pain at parting. The weeks sped happily, the English people learnt a great deal of German, and many pleasant acquaintances were formed between people of different nations. The last social gathering was an afternoon tea-party, given by three English ladies. Everybody was on a friendly footing, bad German circulated freely, little jokes of the Summer Course were related and laughed over, a Dane and an English girl made music with the violin and piano, which pleased everybody, and a German doctor exhibited interesting Nuremberg toys. An international gathering of

* Proud and stately castles stand on
The beautiful banks of the Saale.
Their roofs are now fallen, the wind
Sweeps through their halls, and clouds
Pass over them.

† Castles stand on the mountains,
The Saale flows through the valley,
Maidens dwell in the town,
Everything is as it has ever been.

* Clink glasses. Long live Jena. Hurrah!
The Philistines are pleased with us.
They see in the 'Bursch' what freedom means.
Free is the Bursch, free is the Bursch.

Bursch = student.

this kind is an excellent thing, especially for English people. One becomes tolerant and sympathetic, as one mixes with people of all nations, and the conclusion is that humanity is the same irrespective of nationality or creed.

NEW COMPOSITION STORIES.

STANDARD V. AND 1ST YEAR P.T.'s.

Suitable for 'Unseen Tests' in Reading also.

504.

HIS LEGACY.—A very eccentric doctor had an old servant to whom he bequeathed, on his death, an ancient family trunk, telling him that he would find something there 'which would cause him to have plenty to drink after his master's death.' The servant, full of expectation that his master, under this familiar expression, had left him at least a competency for life, as soon as decency allowed after his master's death, flew to the trunk, when to his great mortification he found that the expected legacy consisted in nothing more than a red herring.

505.

EXCHANGING BAGS.—The Hungarian Minister, when travelling, has for luggage only a small handbag. Returning one Monday to the capital, the Minister met a friend who was carrying a bag exactly like his own. His friend smiled as he noticed the similarity of the bags, and whispered to the Minister: 'My bag is filled with smuggled tobacco. I hope that you will shield me from the custom-house spies.' The Minister looked serious. 'I will do nothing of the kind,' he said; and when they arrived at the end of their journey the Minister called to a custom-house official and said: 'My friend desires to pay duty on a lot of Turkish tobacco he has in his bag.' 'His Excellency is joking!' cried the gentleman, who had meanwhile changed bags with the Minister. 'See; I have no tobacco about me,' and he opened his bag in proof thereof. The Minister looked perplexed for a moment, then took up his friend's bag, and said to the official: 'Well, assess me for the tobacco.' The official did so. The Minister paid the duty and drove off, thanking his friend for his present of twenty pounds of fine tobacco.

506.

RAILWAY TRAVELLERS.—Travelling in a second-class carriage a gentleman had a little misunderstanding with a lady, the only occupant of the compartment besides himself, in reference to the opening of a window. 'You don't appear to know the difference between the second and third-class,' said the lady. 'Oh, madam,' replied he, 'I am an old railway traveller; I know all the class distinctions. In the first-class the passengers behave rudely to the guard; in the third, the guards behave rudely to the passengers; in the second, the passengers behave rudely to each other.'

507.

A STORY OF THE BISHOP.—While the late Bishop of Lichfield was walking one day in the Black Country, he observed a group of colliers seated by the roadside in a semi-circle, with a brass kettle in front of them. He had the curiosity to inquire what was going on. 'Why, yer honour,' replied a grave-looking member of the group, 'it's a sort of wager. Yon kettle is a prize for the fellow who can tell the biggest lie, and I am the umpire.' Amazed and shocked, the good Bishop said reprovingly, 'Why, my friends, I have never told a lie that I know of since I was born.' There was a stunned silence, only broken by the voice of the umpire, who said in deliberate tone: 'Give the Bishop the kettle.'

508.

ASK THE DRIVER.—An Irishman, who traded in smallware, kept a donkey cart, with which he visited the different villages. On one occasion he came to a bridge where a toll was levied. He found to his disappointment that he had not enough money to pay it. A bright thought struck him. He unharnessed the donkey and put it into the cart. Then getting between the shafts himself he pulled the cart with the donkey standing in it on to the bridge. In the course he was hailed by the toll-collector. 'Hey, man,' cried the latter, 'where's your toll?' 'Oh!' said the Irishman, 'just ask the driver.'

509.

THE HERMIT'S OLIVE-TREE.—There was once an aged hermit in the desert, who thought it would be well if he had an olive-tree near his cave. So he planted a little tree, and, thinking it might want water, he prayed to God for rain, and the rain came. Then he thought that some warm sun would be advisable; so he prayed, and the sun shone out. Afterwards he thought that some frost would strengthen his plant, so he prayed, and the frost came, and—it died. Some little while after, the hermit visited a brother hermit, and by his cell-door stood a flourishing olive-tree. 'How came that goodly plant there, brother?' asked the hermit. 'I planted it, and God blessed it, and it grew,' said the other. 'Ah, brother, I too planted an olive-tree; and when I thought it wanted water, I asked God to give it rain; and when I thought it wanted sun, I asked, and the sun shone; and when it needed strengthening, I prayed, and the frost came. God gave me all I asked for my tree as I saw fit, yet it's dead.' 'And I,' replied his friend, 'left my tree in God's hands, for he knew what was good for it better than I.'

510.

AN OBSERVANT IRISHMAN.—An Irish bricklayer was one day brought to the hospital severely injured by a fall from a house-top. The medical man in attendance asked at what time the accident occurred. 'Half-past one, yer honour,' was the reply. On being asked why he came to fix the hour so accurately he answered: 'Because I saw the people at dinner through a window as I was coming down.'

511.

HER REVENGE.—A country woman was returning by train from a market town where she had made a few purchases. Just as the last bell rang, a fussy gentleman, elegantly dressed, rushed into the compartment, flung himself hastily into a corner, pulled out an evening paper, and proceeded to devour its contents. Hardly had he become seated when the woman timidly addressed him: 'I'm very sorry, sir, but——' 'I never listen to beggars,' fiercely interrupted the gentleman. 'If you annoy me further I'll report you.' The woman's eyes flashed, then twinkled; she said no more, and the gentleman retired with an angry frown behind his paper. Presently the train arrived at its destination, when the woman, stepping out, again addressed the churlish individual in the corner: 'I don't care sir, whether ye report me or no, but I want that pound of butter you have been sitting on for the last six miles.'

512.

HE GOT THEM MIXED.—A sergeant was once drilling some recruits. One of them, a country bumpkin, did not know his right hand from his left. The sergeant proceeded to teach him; and after holding them out several times, he seemed to have some idea of which was which. 'Now,' said the sergeant, 'hold them in front of you, and twist them round quickly one over the other. Stop. Now, which is the right and the left?' After staring at them a moment, he said: 'I don't know now, I've gone and mixed them up.'

513.

A FALSE HOPE.—A boy seven or eight years old was beating a drum in the street, when a neighbour appeared and asked, 'How much did your father pay for that drum, my boy?' 'Two shillings, sir.' 'Will you take four for it?' 'Yes, sir; ma said she hoped I'd sell it for twopence.' The exchange was made, the drum put where it wouldn't do any more harm, and the neighbour chuckled over his stratagem. However, when he got home at night there were four drums beating in front of his house, and the drummer boy was prompt to inform him, 'These are my cousins, and I took that money and bought four new drums. Will you give us 16*s.* for them?' The gentleman bowed to the inevitable and retired.

514.

THE PRINCE OF WALES' PARROT.—The Prince of Wales is very fond of animals. Amongst the large collection of pets at Sandringham is a little green parrot which talks splendidly; he is located in the hall, and to every visitor calls out: 'Now then, hip, hip, hurrah for the Queen.' His Royal Highness became possessed of the bird in a peculiar way, having personally bought it of a small boy in Trafalgar Square, whilst crossing it one day.

515.

A POLITE IRISHMAN.—A physician was riding in an omnibus, when an Irishman stepped in and, recognising the doctor, said: 'Och, and sure, and it's Doctor Jones, I perceive.' 'That's my name, sir, but I haven't the pleasure of knowing you,' responded the polite doctor. 'Indeed! but I'm the man who made your last pair of boots, and for which your honour forgot to get a receipt for the payment!' The ladies tittered, the doctor's memor was refreshed, and the Irishman got his money.

VISITS OF INSTRUCTION.

III.—'THE DAILY CHRONICLE' PAPER MILLS, SITTINGBOURNE.

EARLY in June we applied to the well-known firm of paper makers, printers, and publishers, Edward Lloyd, Limited, for permission to visit one of their paper mills with a small party of school children if possible as companions. The permission was readily, even gladly accorded, and help was kindly offered by which the visit might be made the more interesting and instructive.

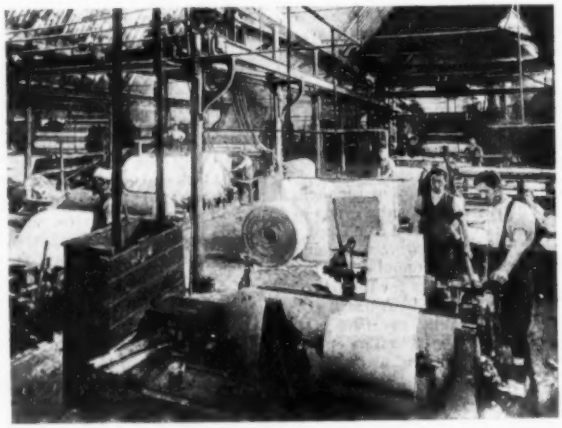
The distance from London being considerable, it seemed desirable to diminish the number of our party, and accordingly we took with us only a few children. Starting from Holborn Viaduct in good time on a fine summer morning, we had a fairly quick journey through the north of Kent, and reached Sittingbourne at about ten o'clock. Points of special interest on the way were, of course, not passed by unnoticed. The observation of these is incidental, but at the same time almost essential to the thorough fulfilment of our purpose in making the journey. So we take note of the Thames as we cross it, and of St. Paul's Cathedral as it towers above the city; and further on we look out for the Crystal Palace crowning Sydenham Hill. Then passing St. Mary Cray we observe the hop gardens and orchards that form such common but pleasant features in a Kentish landscape. At Rochester fresh elements enter into the view in the massive Norman Keep and the Cathedral. The speed of the train, however, as it hurries us on to our destination, does not allow us to dwell long on the scenes by the way. Still, it may be well before we alight from the train to go over a few facts connected with the great business of which the Sittingbourne Paper Mills form only a part.

FIBRE SHEDS, SITTINGBOURNE.

Mr. Edward Lloyd was a man of enterprising spirit. It was in 1843 that he started the weekly paper bearing his name—*Lloyd's News*. Though it soon became popular, it had at first a sale hardly to be compared with its present enormous circulation of about a million copies per week. To secure a constant supply of paper in the large quantities which soon became necessary, Mr. Lloyd, in 1861, started paper mills at Bow, on the river Lea. When it began to be difficult to obtain a sufficient supply of rags he adopted *esparto* grass as a material for the paper manufacture, and acquired large estates in Algeria and the south of Spain where this material could be grown.

The business growing rapidly, became a Limited Company, and in 1877 the *Daily Chronicle*, a local paper in a district of London, was acquired. Since the establishment of this paper as a London daily paper its circulation has increased from 8,000 to 140,000 copies daily. And here, rather appropriately, we arrive at Sittingbourne, for it was the acquisition of the *Daily Chronicle* that made further supplies of paper necessary for the firm, and in the year just mentioned, namely 1877, the Sittingbourne Paper Mill was started to meet the increasing need.

Without delay we present ourselves at the office of the mill with an introduction to Mr. T. E. Denson, the manager. From him we receive a most courteous and cordial welcome, and we are glad to place ourselves at once under his guidance. In the first place our attention is called to the excellent position of the mills. Sittingbourne is a very old town, said to have been one of the resting places in early times of the pilgrims from London to Canterbury. Standing on the east side of Milton Creek, a tidal arm of the channel called the Swale which separates Sheppey from the mainland of Kent, the mills are in close proximity to the Thames, the greatest waterway in the world. Thus, at a wharf alongside the works, the raw materials imported may be unloaded, and the manufactured goods may be placed on board vessels ready to carry them to near or distant parts of the world. This facility of communication is a very important element in the commercial value of the site of these paper mills. Another advantage is the abundant supply of excellent spring water. Some of the neighbouring houses, Mr. Denson tells us, are practically built over water, their foundations resting on piles. In some places you need scarcely do more than make a hole in the ground with your hand and water will bubble up. Water plays such an essential part in the manufacture of paper that its presence in such large quantities contributes much to make this spot one of the finest sites possible for a paper mill.

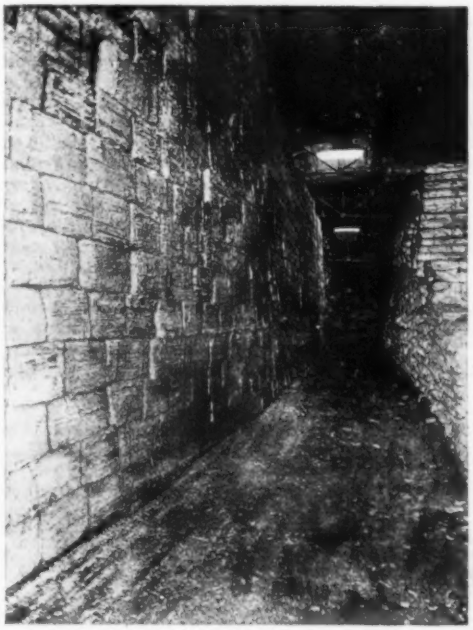


PAPER MACHINE ROOM.

After this preliminary information we are taken by Mr. Denson to the great sheds for storing the principal material which forms the basis of the paper made here. As we enter one of these lofty sheds and proceed along the centre we seem to be walking between two walls made of great rectangular blocks each of which is a bundle of layers of the pulp in the state in which it is imported. It looks as if large pads of thick cardboard or millboard were stacked up, and even when the layers are separated the appearance would almost justify the same impression, except that these layers are limp and rather moist. Now, what do you think the material really is? Well, it is *wood pulp*, chiefly from Norway, but some of it is imported from Belgium. 'The,' Mr. Denson says, as he takes and hands us a piece from one of the bundles, 'is called *soda wood pulp*, because the wood

fibre of which it consists has been treated with caustic soda to disintegrate the fibres or separate them from the pith and other comparatively useless parts of the wood; and this,' handing us another specimen, 'is called *sulphite wood pulp*, because it has been treated with sulphuric acid.' The first piece, which comes from Norway, is like a piece of rather soft card of a very pale brown tint, and slightly mottled. The second, which comes from Belgium, is somewhat thinner and firmer, and nearer to pure white; being stronger and whiter, it is of better quality. The torn edges of each of these kinds have a woolly appearance, and this shows that they consist of the fibrous part of the wood.

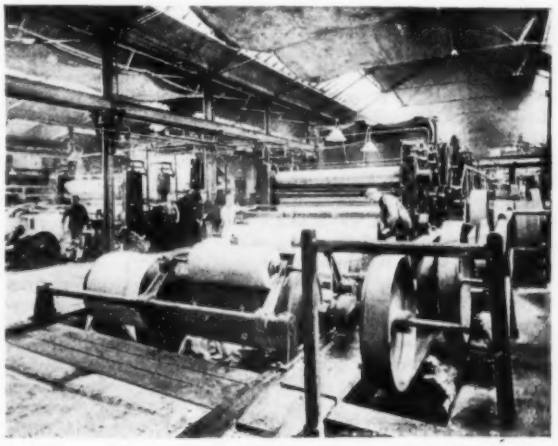
We went into another store shed, and from a cart which was just bringing a load of pulp from the landing wharf, Mr. Denson took another piece of the material. This, as he pointed out, differed from the other specimens. They consisted almost entirely of pure wood fibre, which had been separated by chemical treatment. This was called *mechanical wood pulp*, because it had been prepared from the trees by mechanical means, and consisted largely of the pith and less substantial elements of the wood. It is mixed with the more purely fibrous pulp to give *body* and *bulk* to the paper, or, to use a trade expression, to make a *handle* for the paper. The *strength* and toughness of the paper are entirely due to the fibre. Its substance and stiffness are increased by the addition of the mechanical pulp. Mr. Denson took the greatest pains to help us to understand the nature of these different forms of wood pulp. The storage sheds afford room, he told us, for £20,000 to £30,000 worth of material, and as much as £2,000 worth is consumed in a week.



INTERIOR OF A FIBRE SHED.

On our noticing that the pulp just imported was quite damp, we were informed that as it is brought over from Norway it contains 50 per cent. of moisture. This adds to the freightage, or cost of carriage, but it is better for the manufacture than bringing it over perfectly dry. It is a remarkable fact that the whole cost of bringing the material direct from its source in Norway to the mill is no more than would be the carriage from one end of London to the other.

While in the sheds we learnt some interesting particulars respecting the source of the materials. Several years ago, it appears, the firm acquired some property at Honëfos, a district near Christiania and Drammen, with a natural water force of 12,000 horse-power, and with extensive pine forests on the higher ground. Here the trees are felled and thrown into the mountain torrents, which carry them down, without trouble, to saw-mills and works on the shore of the fiord. The trees are then cut into compact blocks of some 12 inches long. These blocks are pushed against stone wheels turned by water power, and the ground-up substance of the wood is washed into receptacles, where it is collected and boiled with chemicals preparatory to its being pressed into layers or slabs such as we saw piled up in bundles in the storage sheds. The cart-load we saw entering the shed, Mr. Denson said, had probably been growing, five weeks ago, as living trees in a Norwegian forest.



REELING MACHINE.

Mr. Denson further informed us of other uses to which the wood pulp and fibre are applied. The pulp compressed and hardened is used for making railway carriages, including the wheels, and in America even houses are made of it. The fibre is made into a kind of wadding, which, on account of its superior natural medication, surgeons prefer to lint or any other kind of compress for wounds. It has also been spun into what is called *wood-silk*, so fine and soft and strong as to be hardly distinguishable, even by experts, from real silk. But this is by the way.

Having learned so much of the chief material of the paper, we were taken to the mill, the first building we enter being the *stoke-hole* or *boiler-house* of the Old Mill. There are eight boilers for this mill, supplying the steam for two Galloway engines of 400 horse-power each. Mr. Denson explained how fuel is saved here by the use of Green's *Economizer*. This is an arrangement by which the *feed-pipe* which conveys water to the boilers is made to pass through the flue, and thus the heat which passes away with the smoke, and which would otherwise be wasted, is utilised in heating the inflowing water before it reaches the boiler. By this means the water delivered by the feed-pipe comes into the boiler with a force already generated of 5 lbs. to the square inch, and so a smaller consumption of coal suffices to raise the water to the full pressure required. Where the weekly consumption of coal is 750 tons, such a saving as this is of great importance.

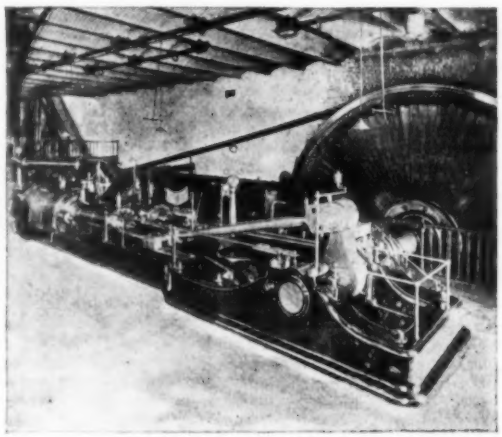
An old boiler lying disused in the neighbouring yard afforded an opportunity, which Mr. Denson readily took, of explaining to the young people how the arrangement of tubes inside brings the water under the influence of the fire.

Another large room adjoining the stoke-hole is the engineering department, which is maintained at a cost of £80 a week to carry on the work necessary to keep the machinery of the mill in good repair and proper working order. A beautiful small engine stationed here proved very attractive.

Next, proceeding on our way to the boiler-room of the New Mill, we had to cross a bridge over a large pond, the water of which was of a milky white appearance. This, Mr. Denson

explained, was used in the mill for the purpose of cleansing and diluting the pulp. The quantity of water used is so enormous that in spite of the abundant supply it is found necessary to use the same water more than once, and especially is it important to economise in dry seasons. The white appearance was due to the chemical substances washed from the pulp. When the Saturday's work was over, the water of the pool would be let off, and by Monday morning it would be brim full of clear fresh water from the many springs from which the supply comes. One was pointed out which gives a supply of 30,000 gallons an hour, another of about the same amount, and a third from which 12,000 to 15,000 gallons per hour flows. The first two were ordinary springs, but the third came from a depth of 500 feet. These were all at one end of the pool, but many others entered at different places. The consumption of water amounted to half a million gallons per day, and if it were not used over and over again they would need a supply of a million gallons per day.

Then we entered the boiler-room, where we found a range of five Galloway's steel boilers, with a number of men engaged in the hot work of stoking. The place was, however, admirably ventilated, and the manager said it was quite a drawing-room compared with many stoke-holes. In the neighbouring engine-room we found a splendid engine of 700 horse-power, constructed by Pollit and Wigzell. The tyre of its great driving wheel is of remarkable breadth, and is fluted so as to carry as many as thirty thick cotton ropes, which form the *gearing*, to communicate the motion and distribute the power to the machinery in various parts of the mill. On a lower stage in part of this engine-house are a number of *dynamos* used for generating the electric light, which is employed all over the mill. It may be mentioned here that this New Mill, so replete with all modern improvements, was added in 1891, when the needs of the firm became greater through the popular development of their newspapers. Besides the three great engines already referred to, we understand that twenty smaller engines, with a total force of 1,250 horse-power, are used for working machinery in various parts of the mill.



ENGINE HOUSE.

From the engine-room a few steps bring us to a large room occupied by what are called *beating machines*. These are large vessels in which the sheets of pulp already described are placed and pushed, by a man acting as feeder, under a roller, which draws them in and passes them to the other side. The roller is armed with steel knives, and works over a slightly hollowed bed similarly armed. Plenty of water is supplied, and the effect of the knives, or teeth, is to tear and draw out the fibres. The machine must be so set that the knives will not entirely cut the pulp and break the fibres, or the resulting manufacture will have no strength and toughness. The water and pulp are kept passing under the roller, and round the great vat, for about two hours, which suffices to reduce it all to a soft pulp of the consistency of batter. The children remarked that it looked like porridge.

During this process of beating or reducing the pulp, colouring matter is mixed with it in cases where colour is required. Thus we saw the pulp being prepared for the ordinary editions of the *Evening News and Post*, the pink tint of which is produced by adding *saffronine* to the water used in the beating machine. In other vats we saw traces of blue colouring matter, and here we were told *aniline blue* was added to counteract the yellowish tinge naturally belonging to the pulp. The paper in this case was being made for the *Daily Mail*. In some of the machines *chloride of lime* was introduced to produce a pure white paper. In a similar way *size*—*resin-size*—is applied to the pulp to give firmness to the paper, and *starch* to make a smooth surface. Mr. Denson stated that as much as £150 a week is paid for starch used in the mills. It is mixed in another part of the mill, and conveyed in a liquid form along pipes, from which it is thrown into the vats of the machines to mix with the pulp. From this statement it will be understood that chemistry enters largely into the paper manufacture, and it will be no surprise to learn that a large *chemical laboratory*, with a staff of experts, forms an important branch of the establishment.

After the pulp has been thoroughly beater and drawn in the beating machine, and so far as is necessary coloured or bleached and sized or starched in the bleaching machine, it is run into vats, and all the water is run off until it becomes of the consistency of mortar, or rather, as one of the children said, like modelling clay. In this state it can be dug out with a sort of spade. Trucks are loaded with it, and it is taken to washing and draining machines. Mixed and agitated with copious supplies of water, it is at length made into a uniform thin fluid and passed into large pipes. These pipes convey it to the paper-making machine, where they pour it on to a wide web of fine wire gauze with about 4,000 holes to the square inch. Over this web it runs like a wide shallow stream, which is kept from overflowing at the sides by raised borders. As it goes on the water gradually drains through the wire-webbing and leaves the film of pulp with less and less moisture. After passing over *vacuum* or *suction boxes* with which pumps are connected, the thin layer of pulp is dry enough to hold together without the wire gauze under it, and it continues to pass under and over a considerable number of large cylinders, and so becomes constantly drier and firmer. In its course it is heated and pressed by rollers, and finally wound as a continuous sheet of paper on a reel of the width of the machine, or is cut into two or three narrower pieces as required, and wound on two or three reels. The length of paper on one reel varies, but it is sometimes as much as six miles, often four or five. Some of the paper we saw made began its course as a pink river some eight feet wide, and ended as three massive reels of paper to be made later on into quires and reams of the *Evening News*.

Another machine was making the green paper used for special editions of an evening paper, and another was making the stronger paper used for the *Daily Mail*. This latter machine, we were told, probably turns out a larger quantity of paper per week than any other, as much as 120 tons. Mr. Denson said that by the end of the day's work, the production of the whole mill for the week would amount to about 460 tons of paper.

During the processes of drying and pressing, it appears that a great deal of electricity is generated in the roll of paper, and this was shown by the way in which the long hair of one of our party was attracted to the revolving roll.

From the great machine-room where the paper was made we were taken to another close at hand to see the *reeling machines* at work; for, after the first forming of the roll, the paper is unwound from the one reel and wound afresh on to another. But in the course of this operation its edges are cut evenly, and its length measured and recorded by a contrivance with dials like those of a gas meter. The paper is also damped again so as to be ready for use by the printer. This being completed, round wooden ends are used for packing the reels, and they are wrapped in strong brown paper, on which are stated the length in yards, the width, the weight, the date of making, and the date of wetting, as well as a mark to show its destination. One of the reels we saw measured 6,860 yds.,

or nearly four miles long, 71¾ inches wide, and weighed about three-quarters of a ton. In the warehousing-room we saw many reels ready for exportation to Australia, to be used for the *Adelaide Register*, the *Melbourne Age*, and other papers. A very large proportion of the paper used in Australia is made at this mill, and the weekly export to the Colonies and India amounts to 120 tons. In one part of the store-room an immense portable crane was lifting these heavy reels of paper and stacking them in lofty piles.

The shavings cut from the rolls of paper are carried in huge bundles to the beating machines, to be mixed with fresh pulp and re-made. Old paper, however, we were told, is not worth re-manufacture, as the strength of the fibre is exhausted by use.

There are in these Sittingbourne Mills several other departments which we did not see; but they are engaged in the same sort of work, making paper for other newspapers, especially for the *Daily Chronicle* and *Lloyd's Newspaper*. For these the machinery and processes are, of course, similar, and, as Mr. Denson said, it would practically be going over the same ground.

Many people from long association are apt to think of *rags* as the chief material from which paper is made. It is true that the best kinds of writing paper continue to be made from rags, but the supply of the old material is not sufficient to make more than a fractional part of the paper required, and wood, esparto grass, and other vegetable fibres have almost entirely superseded rags as the materials for ordinary kinds of paper. It may be worth while to state, however, that the processes of manufacture are in most respects the same for rags and other materials as those we have described, except that in the case of rags there are the preliminary stages of sorting, cutting into pieces, and washing before the beating or separating of the fibres.

The very finest kinds of paper continue to be made by hand. In this the processes are in principle the same, but they are especially interesting, because they can be easily followed. We have recollections of a visit paid nearly forty years ago to a little country paper mill of the old style, where the workman dipped his wire-work frame into the vat of prepared liquid pulp, and having lightly shaken it to make it level and uniform, placed it on *felt*, and so on in alternate layers, which were then pressed and dried, and glazed and dried again. But one fact may be mentioned to show how small a proportion hand-made paper bears to machine-made nowadays. The last edition of the 'Encyclopædia Britannica' gives as the estimated annual production of hand-made paper throughout Great Britain about 70 tons. Contrast this with 450 tons per week made by the machines at the Sittingbourne Mills.

As we left the mills and our kindly guide at midday, we found we had an hour or two to spare, and we did not lose the opportunity of a look about Sittingbourne and the neighbourhood. We spent a few minutes in the church, which has not much of striking interest. Then we walked through orchards, where cherries were beginning to gleam, and fields of corn and pulse, to the Recreation Ground, encircled with shrubs and flowers, and to the fine park surrounding Gore Court, where the children delighted in picking daisies and buttercups, and in listening to the joyous skylark's song and the mellow cawing of the rooks. Then to the station and back to London to talk over and arrange our store of freshgleaned knowledge.

We have now only to express our hearty thanks to the firm of Edward Lloyd, Limited, for the permission they so readily granted us to visit their Sittingbourne Mills, and to reproduce certain illustrations from their handsome volume, 'A Glimpse into Paper-making and Journalism'; and further, to gratefully acknowledge the great kindness shown us by Mr. Denson and the painstaking manner in which he helped to make our visit profitable and interesting.

Next Month the subject of our Visit of Instruction will be 'A Walk in the Country.' With original Illustrations.

COURSE 'B' IN ARITHMETIC.

A COMPLETE SYLLABUS FOR A YEAR, IN MONTHLY SECTIONS, WITH TESTS.

BY B. ELDERKIN,
Model School, Westminster Training College.

For Introductory Notice and First Month see February number of PRACTICAL TEACHER.

STANDARD I.

Syllabus—7th Month.

(*a*) Add and subtract up to 90.
(*b*) Multiplication by 2–5 up to 99.
(*c*) Division by 2–4 up to 99.
(*d*) Revise Tables.

Test.

1. How many are 13, 9, 45, and 12 slates?
2. A boy had 74 pencils and gave away 29. How many were left?
3. How many are 5 times 17 pencils?
4. Divide 65 by 4.

STANDARD II.

Syllabus—7th Month.

(*a*) Four rules up to £6.
(*b*) Revise tables.

Test.

1. Add together 13s. 8½d., £2 14s. 9¾d., £1 15s. 10½d., and 8s. 6½d.
2. How much greater are 139d. than the same number of farthings?
3. What would be 3 times 5s. 6d.?
   4 ,, 2s. 9½d.?
   7 ,, 13s. 8½d.?
4. Divide £4 7s. 6d. between 7 boys.

STANDARD III.

Syllabus—7th Month.

(*a*) Simple and Compound Multiplication and Division by 27, 37, 47, etc.
(*b*) Simple and Compound Addition and Subtraction.

Test.

1. Add 903, 753, 389, and 583, and take your answer from 5641?
2. What would 27 times 1057 nuts be?
3. Multiply £1 3s. 9½d. by 47.
4. Divide £13 14s. 9d. by 67.

STANDARD IV.

Syllabus—7th Month.

(*a*) Division of Money.
(*b*) Weights (tons, cwts. and qrs.).

Test.

1. Change 5614 qrs. to tons.
2. Multiply 15 tons 19 cwt. 3 qrs. by 78.
3. Divide 15 tons 13 cwt. 1 qr. by 7.
4. Divide £61 13s. 9½d. by 75.

STANDARD V.

Syllabus—7th Month.

(*a*) Compound Practice (Time and Weight).
(*b*) Reductions in Area.

Test.

1. Find wages for 3 years 7 months 3 weeks at £156 per year.
2. 7 tons 13 cwt. 3 qrs. 16 lbs. at £7 10s. 6d. per cwt.
3. $3 + \frac{(\frac{1}{6} \text{ of } 7\frac{5}{7})}{\frac{5}{7} + \frac{1}{2}}$.
4. (*a*) Reduce 17 ac. 4 sq. ch. 85 sq. links to sq. links.
   (*b*) ,, 68,093 sq. yds. to acres.

STANDARD VI.

Syllabus—7th Month.

(*a*) Mensuration of Squares and Rectangles. (*Boys.*)
(*b*) Exercises in Decimals. (*Girls.*)

Test.—(Boys.)

1. A room is 1100 sq. yds. in area; it is 12 yds. wide; find its length?
2. Find the cost of a carpet 5 yds. wide and 6 yds. long at 1s. 2d. per sq. foot.
3. What would be the cost of papering a room 40 ft. long, 20 ft. wide and 12 ft. high with paper 27 inches wide, at 2½d. per yard?
4. Find the area of a square court-yard whose side is 42 yds. 2 ft.

Test.—Girls.

1. ·309 × 5·79 × 1·01.
2. Find the Interest on £175·75 for 3·5 yrs. at 2·25 per cent.
3. Reduce 12 yds. to the decimal of half-a-mile.
4. Find the value of 18·25 tons of coal at £13·5 for 6·75 tons.

STANDARD VII.

Syllabus—7th Month.

(*a*) Income derivable from Stock.
(*b*) Investment to secure a given income.

Test.

1. I invest £1000 in the 4% at 90. What income shall I derive?
2. Which is the better investment, and by how much per cent.—
   4% at par,
   (or) 3% at 85?
3. How much money must I put into the Post Office Savings Bank to obtain an income of 25 shillings a week?
4. What total income would be derived from £500 invested in 10% Gas Shares worth £180, and the same sum invested in 4½% Railway Shares worth £120?

TESTS—SEVENTH MONTH ANSWERS.

Standard I.—(1) 79; (2) 45; (3) 85; (4) 16+1.

Standard II.—(1) £5 12s. 11d.; (2) 8s. 8¼d.; (3) (*a*) 16s. 6d., (*b*) 11s. 2d., (*c*) £4 15s. 9⅜d.; (4) 12s. 6d.

Standard III.—(1) 3013; (2) 28,539; (3) £55 18s. 2½d.; (4) 4s. 1¼¼d.

Standard IV.—(1) 70 tons 3 cwt. 2 qrs.; (2) 1247 tons 2 qrs.; (3) 2 tons 4 cwt. 3 qrs.; (4) 16s. 5½d. + 47.

Standard V.—(1) £568 15s.; (2) £1,158 0s. 10½d.; (3) 4 1/17; (4) (*a*) 1,740,085 sq. links, (*b*) 14 ac. 0 rds. 11 po. ¼ yd.

Standard VI.—(*Boys.*)—(1) 91 yds. 8ft.; (2) £15 15s.; (3) £2 4s. 5½d.; (4) 1,820 yds. 4 ft.
(*Girls*).—(1) 1·8070011; (2) £13 16s. 9·675d.; (3) ·01360; (4) £36 10s.

Standard VII.—(1) £44 8s. 10⅜d.; (2) 4%, by £1 7/17%; (3) £2,600; (4) £46 10s. 6⅜d.

'COMPOSITION THEMES AND MORAL TRAINING.'

A SERIES OF LESSONS PREPARED ON A NEW PLAN FOR THE UPPER STANDARDS.

BY B. ELDERKIN,
Model School, Westminster College.

☞ THE LESSONS FULLY MEET THE LATEST INSTRUCTIONS IN THE NEW CODE, 1896.

SEE Introductory Notice in April number.

Hints for successful use of these lessons:—

a. The subject matter may be *read* over by the teacher or even by one of the scholars, or, better still, the teacher may previously read it and give the substance to the class in his own words. He may thus at discretion introduce other illustrations or omit some of those given.

b. The blackboard summary may be put before the class if the teacher is short of time, or, what is much better, a similar one may be made up while the class is being questioned on the matter of the lesson.

c. The whole of the essay should be put before the class at the first lesson, but it will often happen that there will be sufficient matter for two or more written exercises.

d. It is not intended that these lessons should be used exclusively, but that they should form a part of every month's Composition work.

e. Keep the best exercises, so that the Inspector may see the plan upon which they have been worked, as well as the topics written upon, or have a separate exercise book for Composition.

LESSON V.—ON HONESTY.

1. There is nothing more essential to character than honesty. The old proverb says 'Honesty is the best policy.' It would be more true and helpful to say 'Honesty is the *only worthy* policy,' for any other policy than an honest one cannot even be *good*.

2. It is quite true, unhappily, that honesty is not every one's policy, and also true that dishonesty is sometimes apparently successful, but success which is bought by dishonesty cannot in the long run be worth having. Honesty is eternally *right*, and whatever is right must in the end always prove to be best.

3. The great business transactions of the world could not be carried on for a single year unless the great majority of men could be trusted. Most of the money and wealth of the world is left in the hands of persons other than the real owners, and it is right therefore to assume that honesty is the rule and dishonesty the exception in transactions of daily life. Yet dishonesty is far too common, and the results that follow it are so distressing that we cannot begin too early to fortify our minds against the temptations to dishonesty which are sure sooner or later to test every one of us.

4. The name of Wellington is one of which Great Britain is justly proud, for he made his country feared and respected in every quarter of the globe. But Wellington's military genius without his sterling honesty might have left us a heritage of shame and trouble instead of one of glory. In his time pillage and plunder were looked upon as the lawful right of the soldier everywhere. What else could there be worth fighting for? But Wellington from the outset of his command set himself to cure both officers and men of these habits, and to introduce better principles into the army. Two great difficulties stood in his way, one being the force of habit and training, and the other that the soldier was badly paid or often not paid at all. But Wellington was resolute, beginning first with his officers and then proceeding to his men, being convinced that no permanent honour could be gained without honesty.

5. On one occasion he crossed the French frontier in alliance with the Spaniards, but when he found he could not keep the allies from their old habit of pillage he ordered their immediate return to Spain, so that his own good name and that of his troops should not be dishonoured by their practices. Wellington's honesty was further shown by his disbelief of the old proverb, 'Everything is right in war.' Most of his wars were carried on in foreign countries, and in consequence his supplies very often fell short. Although he was usually strong enough to compel the inhabitants of town and country to supply him with food for horses and men, he either paid for it at once or honourably pledged his word that it should be paid for as soon as money could be got from the Government. In this way he often ran heavily in debt for a time, and it sometimes happened that his payments were so greatly in arrear that he was in danger of arrest if he went outside the limits of his own camp. Yet he never forgot his debts, and such was the confidence which his honesty had inspired that the French peasants actually brought their treasures inside the British lines to prevent their being stolen by the soldiers of their own country.

7. One of the most successful men of business of modern times started life in partnership with his brother. Many articles of ordinary use were so heavily taxed in those days that inferior or sham goods were often sold to enable the shopkeeper either to make larger profits or to undersell the genuine

ticle. Pepper was one of these. The younger brother ing a barrel of what looked like pepper in the store and rked "P.D.' asked what it was. 'Pepper dust,' said the ther. The younger brother said 'I will have no pepper t on my conscience,' and after dark he rolled the offend- barrel on to the village green, broke it to pieces, scattered offending dust to the four winds, and then retired to bed. e can hardly wonder that he prospered, for every one who ught at his store had the greatest confidence that his money s being well spent. It is a great stain on the business nour of our nation that fraudulent practices, from which an nest conscience should guard every one, have to be severely ressed by the stern hand of the law.

5. Honesty is not merely required in buying and selling d in the custody of money. Honesty of toil and workman- p is equally to be desired.

The ship-builder who put a worm-eaten plank into a part of e ship where it could not be seen, not only showed himself shonest, but cruelly regardless of the life of his fellow men. striking contrast with this was the conduct of another rson, who, on being asked to put up a fence for a very small n, was told the workmanship need not be carefully done *as uld not be seen*. 'But I shall know it is there,' the man plied, and did the work as well as he could. Thus the ilder, the cabinetmaker, the bootmaker, the tailor, and all work at mechanical trades are required to be as honest the disposal of their labour as the man who, like the milk- n or the grocer, has wares to sell.

6. Hugh Miller, the Scotch naturalist, attributes much of s success in life to the training of an uncle who brought him and who taught him above all things to be honest. He s fortunate afterwards in serving his apprenticeship with a son 'who laid every stone with his conscience.'

7. Men are usually dishonest either because they are in eat hurry to become rich, or because they are indolent and sh to possess, without working for them, the proper rewards industry.

The reports of criminal trials, which appear from day to day the newspapers, show how mistaken these methods are, d yet so great are the temptations that every day there are sh victims to the policy of dishonesty.

8. Here is a simple code of honesty which boys and girls ld with due care keep in its entirety, and so help to establish themselves a strong sense of honour before their tempta- ns become more severe.

a) Perform each duty with a care to do your best.

b) Scorn to pass off as your own work what has not been estly done.

c) Avoid cheating and so-called small lying in your deal- gs with your fellow scholars.

d) Be prompt to restore to its rightful owner anything hich does not belong to you.

e) Respect the rights of others in every way.

f) Execute your errands and commissions with prompt d exact obedience.

g) Observe special care in rendering truthful and accurate count of all money committed to your care.

Blackboard Notes.

a) How would you correct the old proverb ?

b) Are the majority of people honest ?

c) Dishonesty too common.

d) Wellington as a type of honesty.
1. Why he had difficulty in putting down pillage.
2. How he dealt with his Spanish allies.
3. He insists on paying for everything.
4. Action of the French peasants.

e) Contrast the two brothers in starting a business.

f) What is honest work ?

g) Hugh Miller and his teachers.

h) Why men are usually dishonest.

i) Draw up a simple code of honesty suitable for a boy or at school.

NEW PROBLEMS IN ARITHMETIC.

BY T. B. ELLERY, F.R.G.S.
Ex-President of the National Union of Teachers.

THIRD SERIES.

STANDARD III.

The first and second series of 'Problems' having been well received, I have pleasure in submitting, at the Editor's request, a third series.

Every exercise here given will suggest to the practical teacher many others of the same kind. May I say, too, that the blackboard should be freely used in the solution of these problems.

Some of the exercises may, perhaps, be considered too difficult for the particular Standard in connexion with which they are set, but they are given for the purposes of blackboard lessons and as a preparation for more advanced work.

Each exercise should be written on the board, read by the teacher, and then by the class. Every effort should be made to encourage the children to think, and to this end preliminary mental practice should be given before any one problem is attempted.

A

1. By how much does the sum of 356 and 849 exceed the difference between a thousand and 574?

2. Take the product of 36 and 18 from the product of 54 and 16.

3. I gave 6½d. to Rose, 1s. 8½d. to Ellen, and 3s. 4d. to Susan. How much less than a sovereign did I give away?

4. A man bought first 244 eggs and then 540. If he sold them at 8 for a shilling how many shillings did he receive?

5. If I earn 30 shillings a week and spend £1 3s. 6d., how many sixpences do I save?

6. A gentleman has 6s. 8½d. in his purse. He gives half-a-crown to one boy and half that sum to another. What sum remains?

7. A horse, cow, and pony cost in all forty pounds. The pony cost £7 10s., and the cow as much again as the pony. What did the horse cost?

8. 6 farmers have each 48 cows. How many legs have the whole of the cows?

9. A woman earns 3s. 4d. a day, six days of the week. If she spend 15s. a week how long would she take to save half-a-sovereign?

10. A had 3 guineas and B had £2 10s. If A gave B half-a-crown, how much would he still have more than B?

11. A man had 640 apples. He sold one fourth of that number, and placed the rest in baskets, 60 in each basket. How many baskets did he use?

12. If a man save threepence a day, how long would he take to save 15s. 6d.?

13. There are 86 boys altogether in Standards I. and II., and there are 10 boys more in Standard I. than in Standard II. How many boys are there in each Standard?

14. A woman bought 6 loaves of bread and 2 pounds of beef for 3s. 6d. The beef cost 9 pence a pound. What did each loaf cost?

B

15. A gentleman gave 8 half-crowns to one man, and half that amount to another man. How much less than £5 did he give away?

16. A man earns 29s. 6d. a week. He spends 16s. 6d. in food, &c., and his other expenses are a shilling a day. What does he save each week?

17. What number divided by 35 will give a quotient of 267 and a remainder of 23?

18. In a certain train there are 520 people. There are four compartments in each carriage, and 10 people in each compartment. How many carriages are there?

19. Emily earns 4d. while Mary earns a penny. What will Emily earn while Mary earns 4s. 6d.?

20. A lad bought 2 dozen penny stamps, 3 dozen halfpenny stamps, and 1 dozen twopenny stamps, and had a shilling left. How much had he at first?

21. John earned 5s. 9d., Fred 2s. more than that sum, and Harry half-a-guinea. How much more will they want to make up three guineas in all?

22. There are 8 pints in a gallon. How many times could a jug, holding 3 pints, be filled from a tank of water holding 45 gallons?

23. If oranges are sold at the rate of 9 for 6d., how many shall I receive for £5?

24. George had 130 marbles and Harry had none. George gave Harry 54, and of these Harry gave Tom 20. How many had George more than Harry then?

25. A man earns 36s. a week and saves one-fourth of that sum. In how many weeks will he save three guineas?

26. John earns 18s. 6d. a week, and Sam 11s. 9d. John spends 13s. 6½d. and Sam 8s. 10½d. How much has John then more than Sam?

27. One train covers 480 miles in 16 hours, and another 640 miles in 20 hours. How many miles an hour does one train travel faster than the other?

28. 160 boys have between them 2,912 marbles. Each of 36 of the boys has twelve. How many has each of the others, taking one boy with another?

29. 224 apples are to be divided among sixteen boys and twenty-four girls. Each boy is to receive five apples. How many will each girl receive?

C

30. I bought a number of oranges at a penny each, and when paying for them received 3s. 4d. change from a sovereign. How many oranges did I buy?

31. A man bought 50 boxes, each containing 150 oranges, and 40 boxes, each containing 80 oranges. He sold 250 on each of 6 days. How many remained unsold?

32. 5 cows and 5 horses cost in all £210. Each cow cost £24. What did each horse cost?

33. A gentleman gave 16 apples to each of 24 men, and a certain number to each of 8 women. How many did each woman receive if the gentleman gave away 544 apples in all?

34. I bought 160 oranges for 7s. 6d. I sold one half of them at a halfpenny each, and the others at a penny each. Find my gain.

35. A girl had 80 pence and sixteen sixpences in a box. She spent first 5s. 6d. and then 3s. 4½d. What sum remained?

36. I bought 6 books at half-a-crown each, 7 at a crown, and 8 at half-a-sovereign. How much less than £10 did I spend?

37. A man bought 4 cows, 5 horses, and 6 sheep for £158. He sold the cows at £24 each, the horses at £15 each, and the sheep at £3 each. Find his gain.

38. I leave home at 7 o'clock in the morning on my bicycle, and ride 9 miles an hour. How many miles do I ride by three o'clock in the afternoon, allowing one hour's rest on the road?

39. I bought 8 boxes, each containing 120 oranges, and 6 others, each containing 100. I sold the whole in 39 days. How many did I sell on each day?

40. A man bought 20 dozen pears at a penny each. He sold them at 8 for a shilling. Find his gain.

41. I sent 360 pears to market, one half in baskets each holding 20, and the other half in baskets each holding 30. How many baskets were used?

42. There were 8 baskets, each holding 96 buns. These buns were equally divided among 129 boys and 127 girls. How many did each receive?

43. I bought first 360 eggs and then 480 more. How many pence did I pay for the whole, at the rate of 7 for 6d.?

44. A man planted 18 rows of cabbages, each row containing 24 plants. How many rows might he have had if he had planted the cabbages 16 in a row?

45. What is the nearest number greater than 3869 which is exactly divisible by 45?

ANSWERS.

1. 779	16. 6s.	31. 9200 oranges
2. 216	17. 9368	32. £18
3. 14s. 5d.	18. 13 carriages	33. 20 apples
4. 98 shillings	19. 18s.	34. 2s. 6d.
5. 13 sixpences	20. 6s. 6d.	35. 5s. 9½d.
6. 2s. 11½d.	21. £1 19s.	36. £3 10s.
7. £17 10s.	22. 120 times	37. £31
8. 1152 legs	23. 1800 oranges	38. 63 miles
9. 2 weeks	24. 42 marbles	39. 40 oranges
10. 8s.	25. 7 weeks	40. 10s.
11. 8 baskets	26. 2s. 1d.	41. 15 baskets
12. 62 days	27. 2 miles an hour	42. 3 buns each
13. St. I. 48; St. II. 38	28. 20 marbles	43. 720 pence
14. 4d.	29. 6 apples	44. 27 rows
15. £3 10s.	30. 200 oranges	45. 3870

Owing to pressure on our space this Month we are unable to insert Answers to the 'Arithmetic Prize Papers' as promised. Subscribers can have the Solutions posted to them by sending a Post Card to the Office of this Journal.

OUR 1897 CERTIFICATE CLASS.

BY J. C. HOROBIN, M.A.,
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The Examination for Certificates will commence on Monday, 12th July 1897, at 2 p.m.

The general conditions for candidates are to be found in Articles 55–64 and 116–121 of the current Code.

Reading.

This is one of the most important of the subjects, and also one of the most difficult to obtain good marks.

Students must somehow get actual practice in reading *to* a critic. Any head teacher properly approached would give assistance, but if this is not obtainable, then steps should be taken to secure the help of some educated friend. The practice should be continuous, and it is most important to secure good editions of the text, especially in the poetry.

The Clarendon Press edition of 'The Tempest' is good in all respects; Macmillan, Moffatt, and Arnold also publish suitable editions.

Any edition of 'Woodstock' will do if it is good large print.

Ruskin's 'Frondes Agrestes' is published in cheap form by Geo. Allen, Charing Cross Road.

Macmillans publish a special edition of 'The Golden Treasury' for the Certificate work at reduced prices, direct from them.

The leading articles in any of the great daily newspapers furnish good unseen practice, and it is well to utilise the English books and Green's 'History' for the same purpose.

Repetition.

The general remarks on reading apply equally here.

Though there is considerable latitude of choice, I find it on the whole best to choose the repetition from the set English books.

In the choice of passages, one at least should be such as appeals strongly to the student.

After that it is well to make a choice which will give illustrations of the peculiar style and beauty of the author.

There is NO advantage in the lines being continuous, rather the other way, as it is not likely that 300 lines consecutively will be equally good, and what is learned ought to be of the best.

Macmillans publish cheap and good editions of 'Tennyson,' both for first and second year English.

I think the Clarendon Press edition of the 'Shakespeare' on the whole the best to use, though, as said in the note on reading, there are others nearly as good for the purpose.

'Sir Roger de Coverley' is published in good shape by Macmillan and Longmans, the latter edited by the Principal of Swansea Training College (Mr. D. Salmon).

In the second year it is perhaps advisable to divide up the lines on some such plan as 'Tennyson' 100, 'Macbeth' 150, 'Merchant of Venice' 50, which would give a good selection, both for the repetition and for use in the English paper.

Penmanship.

'Many students many styles' precludes any specific direction beyond the general one that the copy setting and the general hand ought not to be antagonistic.

Steady practice in the chosen style is necessary, especially in CAPITALS.

Spelling.

Students should make lists for themselves of words they are not certain about and arrange with another student in turn to dictate passages from standard books for the purpose of practising the EAR and readiness of writing and punctuation.

Very good practice can be obtained from Scott, Ruskin, or Church.

School Management.

The syllabus is much changed, the first year work being in form somewhat lightened, but the second year is proportionately increased.

Generally the first year work is specifically practical so far as sections *a*, *b*, *c*, and *f* are concerned. Section *e* is so general that it might cover the old psychological section and something more, or it may be intended to direct the special attention of the student to a discussion of the different methods possible in sections *a*, *b*, and *c* with reference to this all-important portion of school aim.

Section *d* is peculiarly directed to the infant school, but it is important to note that ALL students are expected to be prepared in this as well as the other sections.

The specific psychology and the elements of ethics as the basis of discipline are added to the second year. So far as I have been able to find no one book covers all the work, nor may a student expect to be able to deal with the paper in the light of personal experience only.

Dr. Gunn's 'Class Teaching' and Wilson's 'Manual' (Nelson), Cowham's 'New School Method and Oral Teaching,' Gladman's 'School Work,' Cartwright's 'Mental Science and Logic' (Nelson) will all be found serviceable.

In the second year a thorough knowledge of the Code and Instructions and Circulars to Inspectors is of great help, and there is no edition so complete and handy as that published by the National Union of Teachers.

The National Society's 'Students' Practice Register' is a very useful compilation for dealing with the compulsory questions on registration.

Composition.

Read good models, practise writing short descriptions and essays, avoiding fanciful imagery and inversions, is the best way of preparing for this test. Write one week and read over the next, to judge the work, is a good rule, where the student is working alone.

Arithmetic.

Hunter's 'Art of Teaching Arithmetic,' Pendlebury's 'Arithmetic,' Wollman's 'Teacher's Arithmetic,' and Cornwall and Fitch's 'Arithmetic,' with any 'Elementary Algebra' will be found quite sufficient for both first and second year work.

Music.

'Music for Pupil Teachers' (Nelson), Curwen's 'Standard Course' or better, the 'School Music Teacher' (Evans and McNaught) will give all that is required.

English.

Dalgleish's 'Higher Grade English' (Nelson) quite covers Section I.

The text-books recommended have been given under Reading and Repetition.

Further notes, etc., will be given during the Course.

Geography.

Brook's 'Descriptive Geography' (Nelson), Meiklejohn's 'Africa' (Holden), and Phillip's 'Certificate Atlas of Africa' will be found to cover the work thoroughly, but students are advised to read Stanley's Works and any other books of travel in Africa that can be obtained.

Some notes from the rarer books will be given later.

History.

Curtis' 'Date Book,' Green's 'Shorter History,' Meiklejohn, Davis' 'Manual for the Period,' and the 'Royal History of England' will be found useful and interesting.

Mathematics.

Any good 'Euclid' such as Todhunter or Laing, with Smith's 'Elementary Algebra,' or one covering the same ground, as Hall and Knight's 'Advanced,' will be found sufficient with the help that will be given in the Course.

Domestic Economy.

Nelson's 'Domestic Economy' quite covers the ground, but Dr. Newsholme's or Dr. Paul's will be found helpful in addition.

Needlework.

Either Miss Rosevear's (Macmillan) or Miss Warren's (Nelson) book will be found sufficient for the purpose.

Notes on Macbeth.

The Clarendon Press edition is one of the best for correct text. The notes are too detailed for pure literature purposes, those in the editions of Macmillan and Moffat being better suited to the Certificate standard. But having regard to the possible questions on text, I should advise the Clarendon Press and Macmillan's edition by Deighton. Mr. Ransom gives a good summary.

ACT I. OF THE PLAY (Macmillan).

Scene I. shows the supernatural as the motive force, and Macbeth as impelled thereby.

Scene II. shows the condition of Scotland.

(*a*) A weak, pusillanimous King.
(*b*) Macdonwald's insurrection.
(*c*) Cawdor's treachery.
(*d*) Norwegian invasion.

Scene III. gives the witches' prophecy, immediately followed by the salutation of Macbeth by the King's messengers as 'Thane of

Cawdor,' which impels Macbeth to question Banquo as to the possibility of the truth of the witches' prophecy. Macbeth sees the only way is through murder, and he hesitates. 'If chance will have me King, why, chance may crown me, without my stir.'

Scene IV. represents Duncan as helpless as a child in the distracted country.

The anti-climax which followed the King's expression to Macbeth—

'More is thy due than more than all can pay,'

in his naming Malcolm Prince of Cumberland, a title which carried with it the succession, seems to have been the proximate cause of Macbeth's action.

Scene V.—Lady Macbeth receives Macbeth's letter, giving an account of the interview with the witches, and shows that he fully believed the promise in their address. The scene gives also a view of Macbeth's character through the intuition of the woman.

In the passage beginning 'Glamis thou art,' etc., the whole meaning turns on the signification of the word 'kindness.' In Shakespeare's time 'kindly' meant natural, and Lady Macbeth seems to read quite clearly the inherent weakness of her husband, in that he desires that which he is too feeble to grasp. Crime he does not revolt at as such, but he fears consequences, and cannot 'screw his courage to the sticking-place.'

The entry of the King's messenger announcing the visit of Duncan and the ensuing conversation of husband and wife shows that they are one in ambition, but that the unscrupulousness of the woman makes her the abler plotter.

Scenes VI. and VII.—The picture of the external appearance of Macbeth's castle is a horrible adornment to the death trap which it is to the guileless Duncan, and Shakespeare's art is at its best in the womanly wife of the rude warrior, whilst showing that in the moral world hers is the stronger nature. Then comes the wonderful painting of the irresolution and vacillation of Macbeth, who is stirred by the chances of failure to withdrawal from the plot, but who is not strong enough to tell his wife the real reason. She sees through his excuse and taunts him with cowardice, and by this means rouses the warrior at the expense of the man.

Act II.

Scene I.—Macbeth sounds Banquo, but finds him faithful, and then, like a true Highlander, he creates for himself objective portents out of subjective conditions.

Scene II.—Here the difference of nature in the man and the woman comes out fully. She dare not strike the blow because of a resemblance in the King to her father. He does not hesitate at that, but, the deed done, is unnerved and full of superstitous terror, whilst she returns to the room to replace the dagger which Macbeth had carried away in his fright.

Scene III.—In meeting Macduff the real strength of Macbeth comes out, and he avails himself of every point to cover the doers of the ghastly crime. Macduff and Lennox are quite taken in, and Lady Macbeth by her fainting attracts attention to herself.

Macbeth might, in relation to the prophecy, have adopted one of three methods of conduct.

(*a*) Take active steps to hasten the fulfilment.
(*b*) Adopt an attitude of indifference.
(*c*) Exert himself to avert his destiny.

In Acts I. and II. Macbeth's attitude was clearly to aid in fulfilling the prophecy.

Between Act II. and Act III. some interval of time is supposed to elapse, and the centre of interest in the opening scene of Act III. is clearly Banquo. He holds in his hands all the threads connecting Macbeth with the murder of Duncan, and besides, is superstitious enough to put some faith in the prophecy so far as it related to himself.

Macbeth shows his recognition of the position of Banquo in the soliloquy: 'To be thus is nothing,' etc.

Macbeth is illogical, and attempts to procure the fulfilment of the first part of the prophecy whilst preventing the latter part. Hence is fear for the present and envy for the future in Banquo.

Act III.

Scene II. shows Lady Macbeth's moral strength as compared with her husband's.

Scene III. is the turning point in Macbeth's luck, and his misfortunes begin in:

'Banquo is down, Fleance fled.'

Scene IV. is the banquet scene, and is remarkable for the fact that whilst in Hamlet the ghost is supposed visible to many, in this case it is only visible to Macbeth, and there is a wonderful study of a man conquering at intervals his superstitious terror and then driven to frenzy by the apparition.

There is a doubt as to the authenticity of Scene V., but supposing it Shakespeare's work it is appropriate enough as showing the witches' queen contriving ruin for the mere mortal who sets himself against the weird sisters.

Scene VI. gives the first intimation of suspicion of Macbeth in the conversation between Lennox and a lord.

Act IV.

Scenes I. and II. is the beginning of the end. Macbeth is goaded to fury and infinite cruelty by the witches in his second visit, whilst Macduff finds himself almost checkmated by the suspicion of Malcolm. The alternate self-damnation and expression of determination to win his own of Malcolm thoroughly unmans Macduff, and Shakespeare introduces Scene III., which enables him to pay a compliment to James I. and give Macduff time to recover.

Act V.

Scene I. shows the nature of the courage of Lady Macbeth. It was in endurance to help her husband, but now the matter is one for purely physical courage she gives way, and she dies, probably by her own hand.

In the final scene Macbeth rises to the necessities of the times. The death of his wife leaves him as calm as Brutus, and he glories in the battle, dying a true soldier.

Acquiescing in the supernatural, he is feeble; defying it, he is strong though unwise.

Prof. Dowden says: 'The theme of the drama is the gradual ruin, through yielding to evil within and evil without, of a man who, though from the first tainted by base and ambitious thoughts, yet possessed elements in his nature of possible honour and loyalty.'

Walter says: 'In Macbeth we have a terrible story of sin and its consequences, we mark the downward career of two souls into moral dissipation and ruin.'

Lady Macbeth seems to be a veritable incarnation of pride, cruelty, self-will, and brutal firmness. She would dash out the brains of her own babe if necessity so required. She is cool and confident to a degree, ready to avail herself of every power of earth, heaven, or hell, to obtain her end.

She has a woman's weakness in physical courage, but a good example of strength of will and resolve.

Coleridge says: 'Hers is the mock fortitude of a mind deluded by ambition; she shames her husband by a superhuman audacity of fancy which she cannot support, but sinks in the season of remorse, and dies in suicidal agony.'

Dr. Johnson considered her as a kind of ogress, and says:—'Lady Macbeth is merely detested.'

Schlegel dismisses her as a species of female fury.

Mrs. Jamieson says: 'Ambition is represented as the ruling motive, an intense overmastering passion, which is gratified at the expense of every just and generous principle, and every feminine feeling. In the pursuit of her object, she is cruel, treacherous, and daring.'

'She appears the more active agent of the two; but it is less through her pre-eminence in wickedness than through her superiority of intellect.'

Lady Macbeth had a lofty determination, and this and her eloquence profoundly moved her husband (I. vii. 3 and 58).

She is cool and confident, but womanly (I. v. 69, vii. 59) (II. ii. 12).

Macbeth is brave (I. ii. 6–19, 54), ambitious (I. v. 17, vii. 7), unpolished (I. iii. 142, vii. 28, viii. 8), not wicked by nature (I. v. 15–20), infirm of purpose (I. iii. 138, II. iii. 72 and 76).

Banquo is the antithesis of Macbeth. His self-reliance, purity, and integrity are clearly manifest (I. iii. 52) (III. i. 49). A brave warrior, loyal subject, and faithful though sluggish friend (II. i. 8).

Duncan is amiably weak (I. iv. 12, vii. 16).

Malcolm is self-governed, suspicious, but patient and prudent (II. iii. 117, IV. iii., V. iv. 4).

Macduff is noble, wise, clear-sighted, prudent, and utterly unselfish (IV. ii. 1, iii. 26, IV. iii. 35).

Gervinus says of the witches: 'They are common in speech, ignoble, half-human creatures, ugly as the evil one, and in like manner old and of neither sex; they are the embodiment of inward temptation.'

The play might be divided and described under the following heads:—

(*a*) The suggestion of sin.
(*b*) The agents of suggestion.
(*c*) The sin.
(*d*) The punishment of sin.

Middleton wrote a play called *The Witch* and there is considerable resemblance between it and *Macbeth*. There is little, if any, evidence to show that Shakespeare borrowed from Middleton, but there is a considerable amount which goes to show that much has been interpolated in the play as it left Shakespeare's hands.

The principal points of resemblance are :—

The Witch.	*Macbeth.*
Song given in full.	Stage directions in III. 5, 33.
" " "	" " IV. 1, 43.
Hecate of Sebastian—'I know	Hecate of Macbeth—'He
loves me not.'	loves for his own ends, not for
	you.'
'I spiced them lately with	'I have drugged their possets.'
drowsy posset.'	
'Come, my sweet sisters, let	'I'll charm the air to give a
the air strike our time.'	sound.'
'The innocence of sleep.'	'The innocent sleep.'
'I'll rip thee down from neck	'He unseam'd him from the
to navel.'	nave to the chaps.'

The principal portions of the play which are of doubtful authorship are :—

I. 2. The slovenly metre, bombastic phraseology, and the inconsistency of lines 52, 53, with Scene 3, lines 72, 73, 112, *et seq.* are not like Shakespeare's work.

I. 3, 1–37; II. 1, 61; III. 2, 54, 55; III. 5, 13; IV. 1, 125–152; IV. 1, 140–159; V. 8, 32, and last 40 lines.

Coming and Passing of Arthur.

Stopford Brooke says :—

'The poem is an allegory of the soul of man warring with sense, and passing on its way through life to death, and through death to resurrection.

'The great rulers of the kingdom of human nature—the intellect, the conscience, the will, the imagination, the divine spirit in man—are shadowed forth in mystic personages.

'Arthur is the rational soul, not the son of Usher and Ygerne, but coming mysteriously from heaven, and washed into Merlin's arms by a great wave. Merlin, who educates him, is intellectual power, with all the magic of science.

'Guinevere is the heart and all we mean by the term.

'The knights are the high faculties in man whom the soul builds in order round it, to do its just and reforming will.

'The Lady of the Lake, who gives the soul Excalibur—the sword of the spirit—is the Church.

'In the mediæval allegory, "The Romance of the Rose," the story is subordinate to the allegory.

'In the "Faerie Queene," Spenser invented a story to suit his conceptions, the story itself being almost equally important and interesting with the allegory.

'But Tennyson took an old story, and worked into it his own conceptions. The story is often greater than the allegory, at other times of equal importance and interest, whilst not unfrequently the two do not fit, but each confuses the other.

'Comparing the poem with "Pilgrim's Progress," it falls short of that triumph. Bunyan's success was due to unconscious imagination. Tennyson's failure was a gigantic intellectual struggle for success.'

Syllabus of Work for the Month.

As a rule Saturday should be kept for writing out to time and without books or other aid the answers to the questions set, and for the practice in Penmanship and Composition.

Students are advised to not only get up the work indicated, but to use the questions as indexes as well as tests.

First Year.

School Management.

1. The Science of Education values, the elementary and class subjects :—
   (*a*) Order of importance.
   (*b*) Value as knowledge and discipline.
2. Qualities of good Reading :—Alphabetic, Phonic, Look-and-say Methods.
3. Alphabet—Junior and Senior lessons in Reading—Code Regulations as to Books and Exercise.
4. Spelling—Teaching and testing—Dictation lesson.

Composition.

1. 'A careless watchman bids the thief come in.'
2. 'Handsome is that handsome does.'
3. The horse.
4. Suez Canal.

Arithmetic.

Not less than six examples from miscellaneous sets ought to be worked per week, as well as those on the particular work set and the examination questions given.

1. Pars. 16–26 (Pendlebury).
   The signs used—history and functions.
2. Pars. 35, 36 (Pendlebury).
   Measures and multiples.
3. Par. 46 (Pendlebury).
   Fractional operations and their geometrical illustrations.
4. Pars. 90–97 (Pendlebury).
   Ratios.

Music.

1. Production of tone and voice classification.
2. Key tone and dominant—accent, pulse, measure—ear tests—hand signs.

English.

1. Classification and inflection of Nouns.
2. Prose and Verse—foot—Iambus—Trochee.
3. Punctuation and figures of speech.
4. The complex sentence.

1. Author's Preface (Roger de Coverley).
2. Revenge.
3. Introduction (Roger de Coverley).
4. Dora.

Geography.

1. Mountain system of Africa.
2. River " "
3. Coast-line.
4. Early history of exploration.

History.

1. Armada (causes—descriptive results).
2. Great Revolution (").
3. Roman occupation.
4. Dunstan, Cromwell, Pitt, Nelson.

1. The right of James I. to the succession.
2. Moral and religious state of England.
3. Main plot and Millenary petition.
4. Milton, Bunyan, Cartwright, Loyola.

Algebra.

1. Definitions—substitution values.
2. Algebra and Arithmetic—proof of formulæ—Positive and Negative quantities.
3. Addition and subtraction.
4. Brackets—Mensuration of rectilineal figures.

Geometry.

1. Propositions I.–IV.; Definitions of II.
2. " V.–IX.; " I. and Proposition I., Book II.
3. Propositions X.–XV.; Propositions 2 and 3, Book II.
4. Revise I.–XV.; Proposition 4 and revise Book II..

Second Year.

School Management.

1. Fitch, Lecture I.
2. Aspects of mental activity.
   Terms or names.
3. The Admission Register.
4. The place of punishments and their variety in a scheme of discipline.

Composition.

As First Year.

Music.

Practical skill is a *sine quâ non*.

1. The modes—fifth step.
2. Minor mode—voice production.

English.

Macbeth :—
Act I., Sc. 1 and 2.
Learn I. 5, 14–29.
Note.—Heath—metre of 7—scansion of captains in Sc. ii. 34.

Merchant of Venice :—
Portia.
Introduction (Clarendon Press).

Tennyson :—
Read the 'Coming through,' marking any lines thought peculiar either for beauty or otherwise.

Geography. } As First Year.
History. }

Algebra.

As First Year.
Also 1. Geometric Progression.
2. Ratio and Proportion.
3. Logarithms.
4. "

Geometry.

As First Year.
Also 1. Definitions of Book III.
2. Propositions 1–4.
3. ,, 5–9.
4. ,, 10–13 and revise.

Needlework.

First Year.
Cutting-out and diagrams of chemise.
Second Year.
Cutting-out and diagrams for boy's shirt.

Domestic Economy.

First Year.—Pars. 74–79
,, 80–88
Second Year.— ,, 107–124
,, 125–145
} Nelson's 'Domestic Economy.'

QUESTIONS FOR TESTS.

FIRST YEAR.

1. Write in large, text and smallhand the word 'Phrenologist.'
2. Dictation :—

When all the motions | of the heavenly bodies | have been reduced | to the dominion of gravitation, | gravitation itself | still remains | an insoluble problem. Why it is | that matter attracts matter, | we do not know; | we perhaps never shall know. | Science | can throw much light | upon the laws | that preside | over the development of life; | but what life is, | and what is its ultimate cause, | we are utterly unable to say. | The mind of man, | which can track | the course of the comet | and measure | the velocity of light, | has hitherto proved | incapable of explaining | the existence of the minutest insect, | or the growth | of the most humble plant. | In grouping phenomena, | in ascertaining their sequences | and their analogies, | its achievements—have been marvellous; | in discovering ultimate causes | it has absolutely failed. | An impenetrable mystery | lies at the root | of every existing thing. | The first principle, the dynamic force, | the vivifying power, | the efficient causes | of those successions | which we term natural laws, | elude the utmost efforts | of our researches. LECKY.

School Management.

1. Write notes of a lesson on 'A Box.'
2. Compare the relative advantages and disadvantages of the Alphabetic and Look-and-Say Methods.
3. What do you understand by articulation, pronunciation, tone, accent, emphasis, and expression as used in reading?

Composition.

Write an essay on :—
'Honest labour bears a lovely face.'

Arithmetic.

1. Define a mixed number, an improper fraction, prime number, factor, present worth, and give an example of each.
2. Subtract 3·2061 of 9 oz. 13 dwts. from 1·0672 of 2 lbs. 5 oz. of troy, and give the answer in grains and decimals of grains.
3. A bicyclist ran 4¼ miles in 17 minutes, the distance covered in the last minute was $\frac{3}{5}$ of that made in the first minute; and the distance made in each successive minute was less than that made in the preceding minute by the same quantity. Find the average and the decrease per minute.

Needlework.

1. Cut out in paper and make up (by tacking) one half of a woman's chemise.
2. Draw diagrams illustrating the cutting out.

Music.

1. Name the three chief chords of the major scale in the order in which they are introduced.
2. What five contiguous notes in *descending* order are separated by the same intervals as :—

(*a*) s f m r d
(*b*) m r d t_1 l_1

English.

1. What do you understand by abstract Noun, gender, case, factitive object?
2. Analyse and parse the words in italics :—

(*a*) 'In short, I *have* acted in all the parts of my life *as a looker-on*, *which* is the character I intend to preserve in this paper.'

(*b*) 'But when the morrow came, she rose and took
The child once more, and sat upon the mound;
And made a little wreath of all the flowers
That grew about, and tied it round his hat
To make him *pleasing* in her uncle's eye.'

3. Explain and comment upon :—

(*a*) Choleric, nonage, the controversies, Will's, Grecian, economy.

(*b*) Dare, off the latch, abegging, Flores, out of gear, inquisition, galleons, holden.

Geography.

1. Draw a map of Africa, showing the mountains and rivers, and name them.
2. What do you know of Mungo Park and his discoveries?

History.

1. What were the immediate causes of the Revolution of 1688? Mention the chief constitutional changes brought about by it.
2. Discuss the pros and cons of James I.'s right of succession.

Domestic Economy.

1. What are the chief objections that may be urged against a diet composed solely of vegetable foods?
2. How is fat digested?

OR,

1. Define point, line, circle, parallelogram, axiom, postulate.
2. From the greater of two given lines cut off a part equal to the less.

SECOND YEAR.

Penmanship.
Dictation.
Composition.
History.
Geography.
Arithmetic.
Geometry.
} As First Year.

School Management.

1. Give a summary of the argument in Fitch as to the rights and responsibility of Assistants.
2. Make out a page of the Admission Register with not less than 10 entries, one at least showing a re-admission.
3. What do you understand by thought, will, feeling, consciousness?

Distinguish between general and collective names.

Algebra.

1. Simplify $(x^2 + xy + y^2)^2 - (x^2 - xy + y^2)^2$.
2. Factorise (*a*) $(5x + 4a)^2 - (4x + 5a)^2$.
(*b*) $x^2 - 18x + 77$.

Needlework.

1. Cut out and tack together one half of a boy's shirt (10 years).

Music.

1. What tones of the Major correspond to the following Minor passage :—

m l m t, r d se, l, f m l m r t, l,

2. What are the names of the following intervals :—*fah-doh*; *re-doh*; *de-fah*?

English.

1. Comment upon and explain :—Hurly burly, gray malkin, pad, dock, broil, kerns, overcharged with cracks, float.
2. Write an essay on the character of Portia.
3. Comment on the following statement :—

'The Coming is the prologue of the idyls, it shows how the poet was hampered in his attempt at an epic by the allegory which now beautifies, now hinders, the story.'

Domestic Economy.

1. How may eggs be best preserved for winter use?
2. How would you stew a steak?

Men only.

FIRST YEAR.

Algebra.

1. Define coefficient, expression, like terms, factor, equation, identity, with examples.

2. Find the value of $\frac{a+\sqrt{a^2+b^2}}{a-2b(a^2-b^2)}$, when $a=-4$, $b=-3$.

Geometry.

1. Define point, plane, circle, axiom.
Which axiom is not obviously true, and how has it been sought to amend it?
2. Prove I. 5.
The vertical bisector of an isosceles triangle is a rectangular bisector of the base.

SECOND YEAR.

Algebra.

1 and 2. As First Year.
3. Define a logarithm, and prove that the log of a product is the sum of the logs of the factors.
Why are the results obtained by logs not strictly accurate?

Geometry.

1. and 2. As First Year.
3. ABCD is a quadrilateral having the sides AB, CD equal, and the diagonals AC, BD also equal. Show that the angles BAD, CDA are equal, and also ABC and DCB.

N.B.—Students who desire their answers to the test questions marked can obtain the conditions and terms by writing direct to Mr. Horobin, sending a stamped directed envelope.

THE INSPECTOR'S NOTE-BOOK.

BY AN INSPECTOR OF SCHOOLS.

Dolce far niente. I am writing these notes under some difficulty. It is the middle of the holiday month. Nearly all educationists are enjoying their well-deserved siesta. 'Dolce far niente' is the order of the day. England's future citizens are paddling and pie-making on the sea-shore, listening to the piercing screams of the sea-gulls and the Wagnerian music of the waves. The schools are silent. The machinery is still. May all return the better for the rest.

* * * * * *

In the keeping of records. It is not for me to meditate. Therefore let us plunge *in medias res*. It is of the keeping of records I would say something. In conversation with a schoolmaster of some renown in the land of silchards, tin, and china clay, I gathered that it was thought the record keeping would for the more part become fictitious. 'No one,' said my friend, 'cares to diagnose and record his own blemishes. There are great opportunities for those who wish to, as it were, cook the accounts. In Dictation, for instance,' he continued, 'how easy it would be at the periodical examination to *select* a piece, and so allow a weak class to produce better results than it does under normal conditions.' My reply is, 'The Inspector's duty now is not to bother himself overmuch about any one particular subject in any one class. Indeed he would often not trouble to find out what the master thought by wading through records. He has to focus the school as a whole. An experienced Inspector, moreover, can easily find out whether the master has a grasp of his school. If he has, then practically the whole thing is settled. My own experience is that the head teachers have no compunction whatever at giving a fair statement respecting the condition of the classes. All fictitious records, like bogus balance sheets, go to pieces when examined into.'

* * * * * *

The slump in paper cutting and the like. Just at present there is a slump, so to speak, in educational handwork. The Varied Occupation business is at a discount. The fact is we were travelling too fast, and a reaction has set in. *Festina lente* is the Englishman's motto. There is just a danger, however, now of a relapse into nothing but the three R's for the lower standards. Do not let us forget Froebel and Pestalozzi. We must aim at linking Standards I. and II. on to the Infant Schools.

Word-building v. Dictation. After experimenting with Word-building for two or three years, most teachers have come to the conclusion that spelling cannot be satisfactorily taught by this method solely.

That it is a useful auxiliary to the teaching of spelling all admit. So very many of the common words which all children should know are so irregularly spelt, that Word-building must be largely supplemented. The sense of sight must be made use of, and pictures formed in the mind of such words. Many of us are so fond of change that we rush from one extreme to the other.

Over-zealous leaders among us shout 'Down with Dictation,' and straightway we purchase some twopenny manuals on the new and royal road to correct spelling, only to court disappointment. Why not at once realise that there can be no short cuts in this subject. Psychology does not count here. Is there any science at all about spelling? In a very good school the other day I found a fourth standard carefully eyeing a piece of Dictation placed on the blackboard with the difficult words underlined. By all means bring in Word-building whenever you can. Don't force it in nor overburden scholars with rules and exceptions. Strike a mean.

* * * * * *

Prepare, for the Night School Season is at hand. This is an appropriate month for a word or two upon Evening Schools. Many of my readers, during the month of the hunter's moon, will be drawing up schemes and time-tables for the approaching winter. I would therefore say a few timely words to you at this season. Do not be too ambitious in the matter of subjects. Teach a few well. Allow the scholar some limited choice. You guide them through. Many pick such things as Shorthand and Physiography, captivated simply by the names. I have met teachers who have literally ruined their schools by teaching too many subjects. In one school in particular I recollect that something like a dozen subjects were down, with the result that very few lads could qualify for grant in any one.

* * * * * *

Tips for the Rurals. First let us deal with country schools. Don't forget to seek aid from the Technical Instruction Committee of your County Council. About a fortnight before commencing, distribute, by means of your day scholars, handbills announcing your intentions, subjects proposed to be taught, names of teachers, etc. Send to neighbouring teachers, where no night school is to be held, asking them to be good enough to supply you with names and addresses of eligible scholars. Circularise these, and hold a preliminary meeting about a week before you intend starting. Give a short address on the advantages of education, and and advise them respecting subjects. Select subjects suited to the locality, where feasible. Take the names, and finish off with a lantern entertainment, or something of that nature.

* * * * * *

Further remarks on Night Schools. Meet twice a week, three times is rather tiring for all, and almost impossible for girls who are wanted at home. Put in two hours' instruction, and meet from about the 4th week in September to the 3rd or 4th week in March. It is generally found advisable to close at Easter. That will give you 24 weeks of four hours = 96 hours, and will be easy for calculating. Carefully arrange your time-table so as to give each subject a fair proportion of the total hours, and be sure to take the difficult subjects during the first hour. Go in for short lessons where possible, especially where oral lessons are to be given. In fact, generally, it is inadvisable to exceed 40 minutes. You would by this means get in three lessons each evening. If three subjects were taught, each would receive 80 minutes per week. Some subjects, like Drawing, can do with a full hour. Needlework, too, for girls must have more than 40 minutes.

* * * * * *

What to Teach in Night Schools. Try and link together a serious subject like Arithmetic with one demanding less mental exertion like Handwriting and Drawing, or with an interesting one like Elementary Science. The girls must, of course, have Needlework. No Evening School would

stand a week if this subject were not taken. Throw in Domestic Economy, Writing, or Cookery, with this, and be satisfied to teach girls two subjects only. Think well over the course of lessons, and sketch out the particular work proposed for each evening as far as you can. This will help you immensely. One word here. Don't attempt too long a course. Try a dozen good lessons, and allow for recapitulation. Most teachers beginning attempt to cover too much ground. There is all the difference in the world between a day school and a night school. Realise this straight away.

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THE family of *Apidæ*, or Bees, possesses the following characteristics: Very much elongated mouth parts, with which they collect honey from many different kinds of flowers, a thick unwieldy body which is usually hairy, wings not like those of wasps folded together longitudinally when in a state of rest, and round eyes.

With regard to their organisation, while most bees are colonial, dwelling in society, there are non-colonial bees possessing no workers. In a few of the latter species (parasitic bees, cuckoo bees) the female lays her eggs in the cells of other species, and the foster parent undertakes the care of the strange larvæ.

The most simple habitations constructed by wild bees that do not live in societies, are built by *Colletes succincta*, *fodiens*, etc. First the parent bee chooses the dry earth of a tank, or the interstices of stone walls cemented with earth instead of mortar. It then proceeds to excavate a cylinder about two inches in depth, running usually in a horizontal direction, and occupies it with three or four cells about half-an-inch long and one-sixth of an inch broad. They are thimble-shaped, and the end of one fits into the mouth of another. These cells are composed of two or three layers of silky membrane secreted by the bee, which is so thin and transparent that the colour of the contents of the cell may be seen through all the layers. Directly she has finished one cell, the bee deposits an egg in it, and fills up the cell with a paste of honey and pollen to nourish the future young. She then stores another cell similarly, and when the whole is finished, she stops up the mouth of the orifice with earth.

Anthidium manicatum, another solitary bee, instead of excavating a hole, constructs her cells in the cavities of old trees, the inside of the locks of gates, etc. Such exposed situations are too cold for the grubs, and it is therefore necessary to protect them. The parent bee, therefore, when she has laid her eggs and stored the cells, plasters the cells with a covering of vermiform masses composed of honey and pollen, and with her mandibles attacks the woolly leaves of *Stachys lanata*, *Agrostemma coronaria*, etc., scraping off the wool, which with her fore legs she rolls into a little ball and carries to her nest. This wool she sticks on the plaster that covers her cells, the warm coating of down being impervious to changes of temperature.

The so-called Carpenter Bees build their habitations with great labour, boring out of solid wood long cylindrical tubes, which they divide into various cells. Perhaps the most remarkable is *Xylocopa violacea*, a native of Southern Europe, which has deep violet-coloured wings, and builds her nest in the upright putrescent espaliers of gardens, in garden seats, doors, and window-shutters, and in vine props. Early in the spring, with her strong mandibles, she bores obliquely downwards in the piece of wood she has selected, pointing her course in a direction parallel with the sides of the wood, and at length forms a cylindrical tunnel from twelve to fifteen inches long and half an inch broad. Sometimes, where the thickness of the wood will allow of it, three or four of these tunnels, nearly parallel with each other, are bored in the same piece. During the excavation of the tunnel a large quantity of fibres of the wood have been detached and lie on the ground. When the bee has deposited an egg at the bottom of the cylinder, together with the requisite store of pollen and honey for the sustenance of the grub, she proceeds at the height of about three-quarters of an inch—the depth of each cell—to construct of particles of these fibres glued together and also glued to the sides of the tunnel, an annular stage or scaffolding. When this is sufficiently hardened, the interior edge affords support for a second ring of the same materials, and thus the ceiling is formed of concentric circles till there remains only a small orifice in the centre, which is closed with a circular mass of agglutinated particles of sawdust. This partition, the ceiling of the first cell, is the flooring of the second, and is about as thick as a crown piece. The whole tunnel is in this manner divided into ten or twelve cells.

We may now inquire what becomes of the first egg laid, which will become a grub, and consequently a perfect bee many days before the last. It cannot pass through eleven superincumbent cells without destroying the other grubs. To provide for its exodus, the bee pierces at the farther end of the tunnel an orifice through which the grubs emerge in order of succession, for each grub, when about to become a pupa, places itself in its cell with its head downwards, and thus is obliged to pierce its cell in this direction.

There have been found near Bristol Carpenter bees which choose a branch of brier or bramble, in the pith of which they excavate a canal about a foot long with from eight to twelve cells separated from each other by partitions of particles of pith glued together.

Another group of bees, the Mason bees, build their houses of stone. The mother bee, *Megachile muraria*, first chooses an angle sheltered by any projection on the south side of a stone wall. She then carefully collects some sand, grain by grain, which she glues together with her saliva into masses the size of small shot and transports in that form to her chosen site. These masses she cements with her saliva to form the foundations. She then raises the walls of a cell, which is about an inch in length and half an inch broad. Having deposited an egg in it, together with a supply of honey and pollen, she proceeds to build other cells similarly till the whole number, ranging from four to eight, is finished. The cells are not arranged in any regular order, some being parallel to the wall, others perpendicular to it, and others inclined to it at different angles. The interstices between the cells are filled up with sand and gluten, and over the whole group is placed a covering of coarser grains. In shape the whole mass is an irregular oblong, and it is so hard that a knife cuts it with difficulty. Other Mason bees, instead of sand, use fine earth made into a kind of mortar with gluten, or a mixture of clay and sand. *Osmia gallarum* places its cells in an abandoned oak gall, and hides it from observation by gluing oak leaves round its home.

The Upholsterer Bees line their holes, excavated in the earth, for the reception of their young with flowers or leaves. A good example occurs in *Megachile papaveris*. Having excavated in some pathway a burrow, cylindrical at the entrance but swelled out below to the depth of about three inches, she cuts out oval portions of poppy petals and carries them to her cell. She then straightens them out and lines the cell with it, giving the bottom three or four coats and the sides too. She then fills it with pollen and honey to the depth of half an inch, lays her egg, wraps poppy leaf over the whole to form a roof, and closes its mouth to the depth of two inches and a half with earth.

The Leaf Cutter Bees, *Megachile centrencularis*, *Megachile Willughbiella*, differ from the preceding in selecting the leaves of trees to line their cells, in excavating longer burrows and filling them with several thimble-shaped cells composed of portions of leaves very curiously convoluted. First the mother bee excavates a cylindrical hole eight or ten inches long in a horizontal direction, either in the ground or the decaying trunk of a tree. She then proceeds to fill this cavity with six or seven cells wholly composed of portions of leaf of the size of a thimble, the convex end of one closely fitting into the open end of another. She first forms the exterior coating, which is oval in form and is composed of three or four pieces larger than the rest. The second coating is composed of portions of equal size, narrow at one end but gradually widening towards the other when the width equals half the length. One side of these pieces is the saw-like, *serrate*, margin of the leaf from which it was taken, which, as the pieces overlap each other, is kept on the outside, the cut edge being within. The third coating is placed over the margins of the leaves forming the first tube, and thus covers and strengthens the junctures. As many as five coatings may be formed, the leaves being bent at the closed end so as to form a convex termination. When the cell is finished it is nearly filled with a rose-coloured mixture of pollen and honey taken from thistle heads. The egg is then deposited and the orifice closed with three exactly circular pieces of leaf. In the concavity is received the convex end of the next cell. It is interesting to watch the bee cut the pieces of leaf for her nest.

'After hovering for some moments over a rose bush, as if to reconnoitre the ground, the bee alights upon the leaf which she has selelected, usually taking her station upon its edge, so that the margin passes between her legs. With her strong mandibles she cuts without intermission in a curved line so as to detach a triangular

portion. When this hangs by the last fibre, lest its weight should carry her to the ground, she balances her little wings for flight, and the very moment it parts from the leaf, flies off with it in triumph; the detached portion remaining bent between her legs in a direction perpendicular to her way.'

Passing now to bees that live in society, a hive of bees will be found to consist of the young brood, a female or queen bee, several hundreds of males or drones, and many thousand workers.

Two sorts of females have been observed among bees, a large one and a small one, but the latter is of rare occurrence and has never been observed to lay eggs.

The Queen Bee has a longer body than that of either the drone or the worker. The tongue is shorter and more slender than that of the workers, with straighter maxillæ. The mandibles do not jut out like theirs into a prominent angle, but terminate in two teeth, the exterior being acute and the interior blunt or truncated. The wings reach only to the tip of the third abdominal segment. The abdomen is considerably longer than the head and trunk taken together, receding from the trunk, elongato-conical, and rather sharp at the anus.

The Male Bee, or Drone, has a thick short clumsy body, very obtuse at each extremity, and the head and trunk are covered with dense hairs. The head is depressed and orbicular, the tongue shorter and more slender than that of the queen bee, and the mandibles smaller. The eyes are very large, meeting at the back part of the head, the wings longer than the body, the abdomen cordate and very short.

The Worker Bee has an oblong body, triangular head, prominent mandibles terminating the head in an angle, long and incurved tongue and maxillæ. The wings extend only to the apex of the fourth segment of the abdomen. The abdomen is a little longer than the head and trunk together, oblong and rather heart-shaped, covered with longish flavo-pallid hairs. The vagina of the sting is straight instead of being curved as in the queen bee.

A bee hive is a miniature city. Its interior consists of several honeycombs fixed to its upper part and sides, arranged vertically at a short distance from each other so that the cells composing them are placed in a horizontal position and have their openings in opposite directions. The distance between one comb and another is about half an inch, a distance sufficient to allow the bees busied on opposite cells to pass each other without difficulty.

Each honeycomb is a flattish cake, mostly composed of hexagonal cells, which are regularly applied to each other's sides and arranged in two layers placed end to end. The shape chosen by bees for their cells is eminently fitted to spare wax, which is not secreted by these insects in large quantities. Cylindrical cells would have been suited to the shape of the bee, but when applied to each they would have left numerous superfluous interstices. Square or triangular cells would have been readily applied to each other, but would have been unsuitable to the bee's cylindrical shape, and would have required more wax. Another important saving in wax is gained by making a common base serve for two strata of cells, and the fact that the base of each cell is usually composed of three lozenge-shaped pieces placed so as to form a pyramidal concavity, thus causing the base of a cell on one side or stratum of the comb to be formed of portions of the *bases* of three cells on the other, and resulting in a greater degree of strength and a greater capacity, with less expenditure of wax. The bottoms and sides of the cells are so economically constructed of wax not thicker than a sheet of writing paper, but the margin at the opening of each cell is made three or four times thicker than the walls in order that the cell may not be injured by the ingress and egress of the workers. Each cell, it must be noticed, is a distinct, separate and independent structure, agglutinated only to the neighbouring cells, and capable of being completely detached from them without injury.

There is considerable variety in the cells of a hive. Those which are built for the males are larger than those destined for the workers. There are prepared for the larvae of the queen bee generally three or four cells, and sometimes many more, in each hive, much larger than the other cells, shaped like a Florence flask, and composed of a material much coarser than common wax. They are placed in a vertical direction with the mouth downwards, and are usually fixed to the lower edge of the comb, from which they project irregularly. These cells in which it is proposed to store honey and pollen differ from those which are to house the larvæ of the workers and drones only in being deeper. When the supply of honey exceeds the capacity of these cells, the bees lengthen the honey cells by adding a rim to them.

Huber was the first to discover that there are two kinds of working bees, the nurse bees and the makers of wax. The former are smaller than the latter, and their work is to build the combs and cells after the latter have laid the foundation, to collect honey, and to feed the larvæ. The makers of wax secrete wax beneath the ventral segments in four pairs of membranous bags or wax pockets, situated at the base of each intermediate segment, one at each side, and only visible on pressing the abdomen so as to lengthen it, the overlapping of the preceding segments usually concealing it. When wax is not wanted in the hive, the wax makers disgorge their honey into the cells.

The formation of the combs in the beehive is a very elaborate process. The wax-makers, having taken a due portion of honey or sugar, from either of which wax can be elaborated, suspend themselves to each other, the claws of the fore-legs of the lowermost being attached to those of the hind pair of the uppermost, and form themselves into a cluster. This cluster consists of a series of festoons, crossing each other in all directions. They thus remain immovable for about twenty-four hours, during which period the formation of wax takes places. One of the bees then detaches itself from a central garland of the cluster, makes a way amongst its companions to the middle of the top of the hive, and turns itself round to form a clear space half-an-inch in diameter. It then suspends itself to the centre of the space. Next it seizes one of the laminæ of wax and carries it to the mouth. It is then worked up by the mandibles with the frothy saliva, and thus acquires a whiteness and opacity which it had not before, and which becomes ductile and tenacious.

The bee then applies these prepared parcels of wax against the vault of the hive, disposing them with the point of her mandibles in the direction which she wishes them to take, till she has applied all the laminæ she separated from her body, and takes a second lamina in like manner. At length she leaves her work, which is resumed by other bees till a little wall of wax, with uneven surfaces, five or six lines long, ten lines high, and half a line thick, descends perpendicularly below the vault of the hive. This is the foundation of the comb.

Next comes the work of the nurse bees. A nurse bee places itself horizontally on the vault of the hive, its head corresponding to the centre of the wall which the wax-makers have left, and which is to form the partition of the comb into two opposite groups of cells. Then rapidly moving its head, with its mandibles it moulds in that side of the wall a cavity, which is to form the base of one of the cells, to the diameter of which it is equal. Another bee proceeds to take its place, deepening the cavity and raising its lateral margins by heaping up the wax to right and left by means of its teeth and fore-feet. After working the bottoms of the cells of the first row into their proper forms, they polish them, while others begin the outline of a new series. They appear to give the proper forms to the bottoms of the cells by means of their antennæ, which are very flexible and readily applied to all parts.

The cells are next constructed. The diameter of those intended for the larvæ of workers is always $2\frac{2}{3}$ lines, for the larvae of the drones $3\frac{1}{3}$ lines. The latter are generally in the middle of the combs or in the upper part, and are never insulated.

The bees never begin two masses for combs at the same time, but scarcely are some rows of cells constructed in the first when two other masses, one on each side of it, are established at equal distances from it and parallel to it, and then again more, exterior to these. The combs are always enlarged and lengthened in a progression proportioned to the priority of their origin, the middle comb being constantly advanced beyond the two adjoining ones by some rows of cells, and the other combs beyond those that are exterior to them.

The first base of the combs on which the bees work usually holds three or four cells. The comb continues of the same width for three or four inches, and then begins to widen for three quarters of its length. The bees engaged at the bottom lengthen it downwards, those on the sides widen it to right and left, and those which are employed above the thickest part extend its dimensions upwards. The more a comb is enlarged below, the more necessary it is that it should be enlarged upwards to the top of the hive. The bees whose work it is to lengthen the comb work with more celerity than those that increase its width, and those that increase its width upwards work more slowly than those that lengthen the comb. Hence it is longer than it is wide, and is narrower towards the top than it is towards the middle.

The substance of the cells is at first of a dead white colour, semi-transparent and soft, but after a few days the cells become yellow, their edges have grown thicker, and they have acquired a consistency which they had not to begin with. Unfinished combs break at the slightest touch, but the finished will bend rather than break, for they are smeared with an unctuous strong-scented reddish varnish. This substance is *propolis*, collected from the buds of the poplar. Huber was the first to see its collection. In the course of his experiments, he saw the bees, with their mandibles, draw a thread from a mass of propolis that was most conveniently situated, and, breaking it by a sudden jerk of the head, take it with the claws of their fore-legs, and then, entering the cell, place it at the angles and sides which they had previously planished. He had been for a long time uncertain whence the bees procured this gummy resin,

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The most simple habitations constructed by wild bees that do not live in societies, are built by *Colletes succincta*, *fodiens*, etc. First the parent bee chooses the dry earth of a tank, or the interstices of stone walls cemented with earth instead of mortar. It then proceeds to excavate a cylinder about two inches in depth, running usually in a horizontal direction, and occupies it with three or four cells about half-an-inch long and one-sixth of an inch broad. They are thimble-shaped, and the end of one fits into the mouth of another. These cells are composed of two or three layers of silky membrane secreted by the bee, which is so thin and transparent that the colour of the contents of the cell may be seen through all the layers. Directly she has finished one cell, the bee deposits an egg in it, and fills up the cell with a paste of honey and pollen to nourish the future young. She then stores another cell similarly, and when the whole is finished, she stops up the mouth of the orifice with earth.

Anthidium manicatum, another solitary bee, instead of excavating a hole, constructs her cells in the cavities of old trees, the inside of the locks of gates, etc. Such exposed situations are too cold for the grubs, and it is therefore necessary to protect them. The parent bee, therefore, when she has laid her eggs and stored the cells, plasters the cells with a covering of vermiform masses composed of honey and pollen, and with her mandibles attacks the woolly leaves of *Stachys lanata*, *Agrostemma coronaria*, etc., scraping off the wool, which with her fore legs she rolls into a little ball and carries to her nest. This wool she sticks on the plaster that covers her cells, the warm coating of down being impervious to changes of temperature.

The so-called Carpenter Bees build their habitations with great labour, boring out of solid wood long cylindrical tubes, which they divide into various cells. Perhaps the most remarkable is *Xylocopa violacea*, a native of Southern Europe, which has deep violet-coloured wings, and builds her nest in the upright putrescent espaliers of gardens, in garden seats, doors, and window-shutters, and in vine props. Early in the spring, with her strong mandibles, she bores obliquely downwards in the piece of wood she has selected, pointing her course in a direction parallel with the sides of the wood, and at length forms a cylindrical tunnel from twelve to fifteen inches long and half an inch broad. Sometimes, where the thickness of the wood will allow of it, three or four of these tunnels, nearly parallel with each other, are bored in the same piece. During the excavation of the tunnel a large quantity of fibres of the wood have been detached and lie on the ground. When the bee has deposited an egg at the bottom of the cylinder, together with the requisite store of pollen and honey for the sustenance of the grub, she proceeds at the height of about three-quarters of an inch—the depth of each cell—to construct of particles of these fibres glued together, and also glued to the sides of the tunnel, an annular stage or scaffolding. When this is sufficiently hardened, the interior edge affords support for a second ring of the same materials, and thus the ceiling is formed of concentric circles till there remains only a small orifice in the centre, which is closed with a circular mass of agglutinated particles of sawdust. This partition, the ceiling of the first cell, is the flooring of the second, and is about as thick as a crown piece. The whole tunnel is in this manner divided into ten or twelve cells.

We may now inquire what becomes of the first egg laid, which will become a grub, and consequently a perfect bee many days before the last. It cannot pass through eleven superincumbent cells without destroying the other grubs. To provide for its exodus, the bee pierces at the farther end of the tunnel an orifice through which the grubs emerge in order of succession, for each grub, when about to become a pupa, places itself in its cell with its head downward, and thus is obliged to pierce its cell in this direction.

There have been found near Bristol Carpenter bees which choose a branch of brier or bramble, in the pith of which they excavate a canal about a foot long with from eight to twelve cells separated from each other by partitions of particles of pith glued together.

Another group of bees, the Mason bees, build their houses of stone. The mother bee, *Megachile muraria*, first chooses an angle sheltered by any projection on the south side of a stone wall. She then carefully collects some sand, grain by grain, which she glues together with her saliva into masses the size of small shot and transports in that form to her chosen site. These masses she cements with her saliva to form the foundations. She then raises the walls of a cell, which is about an inch in length and half an inch broad. Having deposited an egg in it, together with a supply of honey and pollen, she proceeds to build other cells similarly till the whole number, ranging from four to eight, is finished. The cells are not arranged in any regular order, some being parallel to the wall, others perpendicular to it, and others inclined to it at different angles. The interstices between the cells are filled up with sand and gluten, and over the whole group is placed a covering of coarser grains. In shape the whole mass is an irregular oblong, and it is so hard that a knife cuts it with difficulty. Other Mason bees, instead of sand, use fine earth made into a kind of mortar with gluten, or a mixture of clay and sand. *Osmia gallarum* places its cells in an abandoned oak gall, and hides it from observation by gluing oak leaves round its home.

The Upholsterer Bees line their holes, excavated in the earth, for the reception of their young with flowers or leaves. A good example occurs in *Megachile papaveris*. Having excavated in some pathway a burrow, cylindrical at the entrance but swelled out below to the depth of about three inches, she cuts out oval portions of poppy petals and carries them to her cell. She then straightens them out and lines the cell with it, giving the bottom three or four coats and the sides too. She then fills it with pollen and honey to the depth of half an inch, lays her egg, wraps poppy leaf over the whole to form a roof, and closes its mouth to the depth of two inches and a half with earth.

The Leaf Cutter Bees, *Megachile centrencularis*, *Megachile Willughbiella*, differ from the preceding in selecting the leaves of trees to line their cells, in excavating longer burrows and filling them with several thimble-shaped cells composed of portions of leaves very curiously convoluted. First the mother bee excavates a cylindrical hole eight or ten inches long in a horizontal direction, either in the ground or the decaying trunk of a tree. She then proceeds to fill this cavity with six or seven cells wholly composed of portions of leaf of the size of a thimble, the convex end of one closely fitting into the open end of another. She first forms the exterior coating, which is oval in form and is composed of three or four pieces larger than the rest. The second coating is composed of portions of equal size, narrow at one end but gradually widening towards the other when the width equals half the length. One side of these pieces is the saw-like, *serrate*, margin of the leaf from which it was taken, which, as the pieces overlap each other, is kept on the outside, the cut edge being within. The third coating is placed over the margins of the leaves forming the first tube, and thus covers and strengthens the junctures. As many as five coatings may be formed, the leaves being bent at the closed end so as to form a convex termination. When the cell is finished it is nearly filled with a rose-coloured mixture of pollen and honey taken from thistle heads. The egg is then deposited and the orifice closed with three exactly circular pieces of leaf. In the concavity is received the convex end of the next cell. It is interesting to watch the bee cut the pieces of leaf for her nest.

'After hovering for some moments over a rose bush, as if to reconnoitre the ground, the bee alights upon the leaf which she has selelected, usually taking her station upon its edge, so that the margin passes between her legs. With her strong mandibles she cuts without intermission in a curved line so as to detach a triangular

portion. When this hangs by the last fibre, lest its weight should carry her to the ground, she balances her little wings for flight, and the very moment it parts from the leaf, flies off with it in triumph; the detached portion remaining bent between her legs in a direction perpendicular to her way.'

Passing now to bees that live in society, a hive of bees will be found to consist of the young brood, a female or queen bee, several hundreds of males or drones, and many thousand workers.

Two sorts of females have been observed among bees, a large one and a small one, but the latter is of rare occurrence and has never been observed to lay eggs.

The Queen Bee has a longer body than that of either the drone or the worker. The tongue is shorter and more slender than that of the workers, with straighter maxillæ. The mandibles do not jut out like theirs into a prominent angle, but terminate in two teeth, the exterior being acute and the interior blunt or truncated. The wings reach only to the tip of the third abdominal segment. The abdomen is considerably longer than the head and trunk taken together, receding from the trunk, elongato-conical, and rather sharp at the anus.

The Male Bee, or Drone, has a thick short clumsy body, very obtuse at each extremity, and the head and trunk are covered with dense hairs. The head is depressed and orbicular, the tongue shorter and more slender than that of the queen bee, and the mandibles smaller. The eyes are very large, meeting at the back part of the head, the wings longer than the body, the abdomen cordate and very short.

The Worker Bee has an oblong body, triangular head, prominent mandibles terminating the head in an angle, long and incurved tongue and maxillae. The wings extend only to the apex of the fourth segment of the abdomen. The abdomen is a little longer than the head and trunk together, oblong and rather heart-shaped, covered with longish flavo-pallid hairs. The vagina of the sting is straight instead of being curved as in the queen bee.

A bee hive is a miniature city. Its interior consists of several honeycombs fixed to its upper part and sides, arranged vertically at a short distance from each other so that the cells composing them are placed in a horizontal position and have their openings in opposite directions. The distance between one comb and another is about half an inch, a distance sufficient to allow the bees busied on opposite cells to pass each other without difficulty.

Each honeycomb is a flattish cake, mostly composed of hexagonal cells, which are regularly applied to each other's sides and arranged in two layers placed end to end. The shape chosen by bees for their cells is eminently fitted to spare wax, which is not secreted by these insects in large quantities. Cylindrical cells would have been suited to the shape of the bee, but when applied to each they would have left numerous superfluous interstices. Square or triangular cells would have been readily applied to each other, but would have been unsuitable to the bee's cylindrical shape, and would have required more wax. Another important saving in wax is gained by making a common base serve for two strata of cells, and the fact that the base of each cell is usually composed of three lozenge-shaped pieces placed so as to form a pyramidal concavity, thus causing the base of a cell on one side or stratum of the comb to be formed of portions of the *bases* of three cells on the other, and resulting in a greater degree of strength and a greater capacity, with less expenditure of wax. The bottoms and sides of the cells are also economically constructed of wax not thicker than a sheet of writing paper, but the margin at the opening of each cell is made three or four times thicker than the walls in order that the cell may not be injured by the ingress and egress of the workers. Each cell, it must be noticed, is a distinct, separate and independent structure, agglutinated only to the neighbouring cells, and capable of being completely detached from them without injury.

There is considerable variety in the cells of a hive. Those which are built for the males are larger than those destined for the workers. There are prepared for the larvae of the queen bee generally three or four cells, and sometimes many more, in each hive, much larger than the other cells, shaped like a Florence flask, and composed of a material much coarser than common wax. They are placed in a vertical direction with the mouth downwards, and are usually fixed to the lower edge of the comb, from which they project irregularly. Those cells in which it is proposed to store honey and pollen differ from those which are to house the larvæ of the workers and drones only in being deeper. When the supply of honey exceeds the capacity of these cells, the bees lengthen the honey cells by adding a rim to them.

Huber was the first to discover that there are two kinds of working bees, the nurse bees and the makers of wax. The former are smaller than the latter, and their work is to build the combs and cells after the latter have laid the foundation, to collect honey, and to feed the larvæ. The makers of wax secrete wax beneath the ventral segments in four pairs of membranous bags or wax pockets, situated at the base of each intermediate segment, one at each side, and only visible on pressing the abdomen so as to lengthen it, the overlapping of the preceding segments usually concealing it. When wax is not wanted in the hive, the wax makers disgorge their honey into the cells.

The formation of the combs in the beehive is a very elaborate process. The wax-makers, having taken a due portion of honey or sugar, from either of which wax can be elaborated, suspend themselves to each other, the claws of the fore-legs of the lowermost being attached to those of the hind pair of the uppermost, and form themselves into a cluster. This cluster consists of a series of festoons, crossing each other in all directions. They thus remain immovable for about twenty-four hours, during which period the formation of wax takes places. One of the bees then detaches itself from a central garland of the cluster, makes a way amongst its companions to the middle of the top of the hive, and turns itself round to form a clear space half-an-inch in diameter. It then suspends itself to the centre of the space. Next it seizes one of the laminæ of wax and carries it to the mouth. It is then worked up by the mandibles with the frothy saliva, and thus acquires a whiteness and opacity which it had not before, and which becomes ductile and tenacious.

The bee then applies these prepared parcels of wax against the vault of the hive, disposing them with the point of her mandibles in the direction which she wishes them to take, till she has applied all the laminæ she separated from her body, and takes a second lamina in like manner. At length she leaves her work, which is resumed by other bees till a little wall of wax, with uneven surfaces, five or six lines long, ten lines high, and half a line thick, descends perpendicularly below the vault of the hive. This is the foundation of the comb.

Next comes the work of the nurse bees. A nurse bee places itself horizontally on the vault of the hive, its head corresponding to the centre of the wall which the wax-makers have left, and which is to form the partition of the comb into two opposite groups of cells. Then rapidly moving its head, with its mandibles it moulds in that side of the wall a cavity, which is to form the base of one of the cells, to the diameter of which it is equal. Another bee proceeds to take its place, deepening the cavity and raising its lateral margins by heaping up the wax to right and left by means of its teeth and fore-feet. After working the bottoms of the cells of the first row into their proper forms, they polish them, while others begin the outline of a new series. They appear to give the proper forms to the bottoms of the cells by means of their antennæ, which are very flexible and readily applied to all parts.

The cells are next constructed. The diameter of those intended for the larvæ of workers is always $2\frac{3}{5}$ lines, for the larvae of the drones $3\frac{1}{3}$ lines. The latter are generally in the middle of the combs or in the upper part, and are never insulated.

The bees never begin two masses for combs at the same time, but scarcely are some rows of cells constructed in the first when two other masses, one on each side of it, are established at equal distances from it and parallel to it, and then again more, exterior to these. The combs are always enlarged and lengthened in a progression proportioned to the priority of their origin, the middle comb being constantly advanced beyond the two adjoining ones by some rows of cells, and the other combs beyond those that are exterior to them.

The first base of the combs on which the bees work usually holds three or four cells. The comb continues of the same width for three or four inches, and then begins to widen for three quarters of its length. The bees engaged at the bottom lengthen it downwards, those on the sides widen it to right and left, and those which are employed above the thickest part extend its dimensions upwards. The more a comb is enlarged below, the more necessary it is that it should be enlarged upwards to the top of the hive. The bees whose work it is to lengthen the comb work with more celerity than those that increase its width, and those that increase its width upwards work more slowly than those that lengthen the comb. Hence it is longer than it is wide, and is narrower towards the top than it is towards the middle.

The substance of the cells is at first of a dead white colour, semi-transparent and soft, but after a few days the cells become yellow, their edges have grown thicker, and they have acquired a consistency which they had not to begin with. Unfinished combs break at the slightest touch, but the finished will bend rather than break, for they are smeared with an unctuous strong-scented reddish varnish. This substance is *propolis*, collected from the buds of the poplar. Huber was the first to see its collection. In the course of his experiments, he saw the bees, with their mandibles, draw a thread from a mass of propolis that was most conveniently situated, and, breaking it by a sudden jerk of the head, take it with the claws of their fore-legs, and then, entering the cell, place it at the angles and sides which they had previously planished. He had been for a long time uncertain whence the bees procured this gummy resin,

when it occurred to him to plant some cuttings of a species of poplar (before their leaves were developed, when their leaf buds were swelling and besmeared and filled with a viscid juice) in some pots placed in the way of the bees that went from his hives. Almost directly a bee lighted on a twig, and with its mandibles opened a bud and drew from it a thread of the viscid matter which it contained. The propolis is soft, red, aromatic, will pull out in a thread, and imparts a gold colour to white polished metals. It is employed in the hive, not only in finishing the combs, but also in stopping every chink or orifice by which cold, wet, or any enemy can enter. They also cover with it the sticks which support the combs, and often spread it over a large part of the interior of the hive. Knight succeeded in getting some bees to use an artificial kind of propolis. He caused the decorticated part of a tree to be covered with a cement of bees' wax and turpentine. Finding this suitable for their purpose, they made use of it as if it had been propolis.

The head of the hive is the queen bee. Nor does she tolerate any rivals. Sixteen days is the time for her existence in her preparatory states. During three she remains in the egg. When hatched she feeds for five days, is covered in, spins her cocoon—which occupies another day—remains perfectly still for two days and sixteen hours, and then assumes the pupa state for four days and eight hours. There are indeed from sixteen to twenty royal cells in the same nest, but the queen first liberated proceeds to sting the others to death. However many queens are introduced into a hive, all but the strongest one will perish.

When, however, queens are wanted to lead forth swarms, the first swarm is conducted by the old queen, and as the other queens come forth successively, they lead successive swarms. The workers appear to regulate this procedure.

After the cells are covered in, they remove here and there a portion of the wax from their surface so as to render it unequal; and immediately before the last metamorphosis takes place the walls are so thin that all the motions of the inclosed pupa are perceptible through them. On the seventh day, the part covering the head and trunk of the young queen is almost entirely unwaxed, but she does not yet come forth. To prevent her leaving her cell and destroying those in the other cells, as soon as the workers perceive through the transparent cell that the young queen has cut circularly through her cocoon, they immediately solder the cleft up with some particles of wax, and so keep her a prisoner against her will. For two days she is kept back and fed by the workers with honey, so that on emerging she may be perfectly fit to take her flight. When she comes forth, if she approaches the other royal cells, she is chased away by the workers. At last she becomes very much agitated, and a swarm leaves the hive, which she either precedes or follows. The other young queens are treated in the same way till enough swarms have gone forth, when the other queen bees come forth and fight unimpeded till only one remains. It should be noticed that the queens are all liberated in order of seniority.

The old queen of the hive is never interfered with by the workers. When unfavourable weather retards the first swarm, all the royal offspring perishes by the sting of their mother. When she does not do this, jealousy of them causes her to lead forth the swarm.

In England the best season for swarming is from the middle of May to the middle of June, but swarms occasionally occur from April to the middle of August. Sure signs that a hive is preparing to swarm are the appearance of the males and the clustering of the population at the mouth of the hive, together with the fact of few bees going forth from the hive. Another sign is a general hum in the evening, continued during the night. The queen begins to lay her eggs irregularly, runs over the bees in her way, who strike her with their antennæ, and mount on her back. She thus traverses the whole hive, those bees excited by her motions following her and rousing those that are still tranquil on the combs. All the workers run wildly about, and there is a general rush to the outlets of the hive. The queen accompanies them, and the swarm takes place, the heat of the hive having become intolerable.

The queen does not alight at first upon the branch on which the swarm fixes, but as soon as a group is formed and clustered she joins it. After this it thickens more and more, all the bees that are in the air hurrying to their companions and the queen, so as to form a living mass of insects supporting themselves by the claws of their feet. They are so concatenated, each bee suspending its legs to those of another, as to form living chaplets. Before they are housed they often begin to construct a little comb on the branch on which they alight. If no queen goes out with a swarm they return to the hive. If, as sometimes happens, two queens go out with the same swarm, it divides into two bodies, one under each leader, the smaller group eventually joining the larger together with the queen to which they attached themselves. When they are hived she is destroyed by her rival.

A swarm contains from 12,000 to 40,000 bees, and the longest interval between the swarms is from seven to nine days. Fifteen or eighteen days in favourable weather are usually sufficient for throwing the four swarms.

The drones of the hive have a very short life, the eggs that produce them being laid during April and May, and their destruction taking place in July and August. In fine weather they make their flight during the warmest part of the day, and pair with the queen in mid-air, after which they are destroyed by the workers. They first chase them about and drive them to the bottom of the hive. Then they seize them by their antennæ, their legs, and their wings, and kill them by violent strokes of their sting, which they generally insert between the segments of the abdomen. They also attack such male pupæ as were left in their cells, and then dragging them forth suck the fluid from their bodies and cast them out of the hive.

(*To be continued.*)

MODEL ANSWERS TO QUEEN'S SCHOLARSHIP QUESTIONS.

CHRISTMAS 1895.

(*Continued from page* 58.)

ENGLISH GRAMMAR—MEN AND WOMEN—*cont.*

2. Select from the following passage the words containing English or Latin prefixes or terminations, adding a suitable note on each:—

'O Nightingale, that on yon bloomy spray
Warblest at eve, when all the woods are still;
Thou with fresh hopes the lover's heart doth fill,
While the jolly hours lead on propitious May.
The liquid notes that close the eye of day,
First heard before the shallow cuckoo's bill,
Portend success in love; oh, if Jove's will
Have linked that amorous power to thy soft lay,
Now timely sing, ere the rude bird of hate
Foretell my hopeless doom in some grove nigh.'

bloomy From the noun *bloom*, by means of the English adjective suffix *y*. Compare *misty*.

lover From the verb *love*, by means of the English noun suffix *er*, signifying an agent or doer.

jolly From the old French *jolif*, modern French *joli*. The termination *y* in this case is not the same as the *y* above, but is a weakened form of *if* (Lat. adjective termination *ious*). The root of the word is the same as that of 'yule.'

propitious Has Latin prefix *pro*, forward, and adjective termination *ous*, meaning 'full of.' The root of the word is Latin, *petere*, to seek, which originally meant 'to fly.' The word means 'of favourable omen.' The Romans derived their omens from the varying circumstances attending the flight of birds.

liquid Has the Latin adjective termination *id* (L. *idus*). The root of the word means 'to be wet.'

first Contains the English superlative termination *st*. It is really the superlative of *fore*.

before Contains the English prefix *be*, which = by.

shallow Contains the English noun and adjective termination *ow*. The root of the word means 'sloping' or 'shelving.' Compare *meadow*.

portend Contains the Latin prefix *por*, another form of *pro*, towards.

success Contains the Latin prefix *suc* = *sub*, after. It means literally 'a going after.'

amorous Contains the Latin adjective termination *ous*, 'full of.' The root *amor* = 'love.'

timely The suffix *ly* is an English adjective and adverbial termination.

foretell *Fore* is an English prefix, meaning 'before.'

hopeless Contains the English suffix *less*, which means 'without.'

3. Show how you would give a 'word-building' lesson to an upper class on etymological lines.

1. From simple verbs we may by means of prefix form other verbs.

(*a*) By prefixing *un*, we signify the undoing of the action represented by the simple verb, as

un-do, un-bind, un-tie.

(*b*) By prefixing *mis*, we signifiy error or defect, as
mis-take, mis-read, mis-construe.
(*c*) By prefixing *be* we convert intransitive into transitive verbs, as
be-moan, be-speak.

2. From simple nouns or adjectives we may get nouns or adjectives signifying their opposites by adding the prefix *un*, as
un-dress, un-rest, un-real.

3. From verbs we may, by adding *er* or *ar*, form nouns denoting the doer of the action denoted by the verb, as—

Verb.	*Noun.*
Bake	Baker
Beg	Beggar
Lie	Liar
Believe	Un-believer.

We see from the above examples that if the verb ends in *-e*, the *-e* is dropped before adding *-er* or *-ar*.

4. From nouns and adjectives we get abstract nouns by the addition of *-ness*, *-scape*, *th*, etc., as—
Good-ness, land-scape, heal-th, etc.

5. From nouns and verbs we get adjectives by the addition of *-ly*, *-like*, *-en*, *-ward*, etc., as God-ly, child-like (From these we may further form un-godly, un-godli-ness, un-child-like, etc.), wood-en, north-ward, etc.

The above will serve to show how word-building may be taught on etymological lines. Only English prefixes and suffixes have been used. The lesson may be extended, or further lessons given, introducing Latin prefixes and suffixes.

4. Who were the authors of any *five* of the following passages, and in which of their works do they severally occur? Give, approximately, the dates of the authors:—

(*a*) 'Tis better to have loved and lost
Than never to have loved at all.

(*b*) That last infirmity of noble minds.

(*c*) Then none was for a party;
Then all were for the state.

(*d*) How sublime a thing it is
To suffer and be strong.

(*e*) Hoist with his own petard.

(*f*) The shrieks of death through Berkley's roofs that ring,
Shrieks of an agonising king.

(*a*) From Tennyson's 'In Memoriam.'
Lord Tennyson, 1809–1894.

(*b*) From Milton's 'Lycidas.'
Jno. Milton, 1608–1674.

(*c*) From Macaulay's 'Horatius.'
Lord Macaulay, 1800–1859.

(*d*) Longfellow's 'Light of Stars.'
H. W. Longfellow, 1807–1887.

(*e*) Shakespeare's 'Hamlet.'
W. Shakespeare, 1564–1616.

(*f*) Gray's 'Bard.'
T. Gray, 1716–1771.

5. Comment on the history of these words:—gossip, villain, poison, spinster.

Give instances (*a*) of words that have changed in their spelling from that used in the time of Shakespeare; (*b*) of words that have changed in their pronunciation, supporting the instances in the latter case by quotations, if possible.

Gossip is from the M.E. *god*, *God*, and *sib*, related. It meant originally one who had a religious relationship to us, *i.e.*, a sponsor in baptism. Since godparents are usually intimate connections of the persons for whose children they undertake to be sponsors, the word came to mean an intimate connection, and hence a person who talks unreservedly to us.

Villain meant originally a farm servant, from Low Lat. *villanus* (*villa*, a farm). As farm servants in England during the middle ages were serfs, the word came to mean a serf. From this the meaning degraded still further to that of a person of great moral shortcomings. In the same way knave meant originally a 'boy' or 'servant.'

Poison is from the Latin *potio*, a drink, through the French. The word has come to have a bad application only in the sense of a drink which will cause harm or even death to the body. On the other hand, the word *potion*, which is derived directly from the Latin *potio*, has retained its neutral meaning of a 'drink.'

Spinster was originally the feminine form of *spinner*. For instances of the old feminine *ster*, compare the proper names *Brewster*, *Baxter* (Bake-ster). From originally meaning 'a woman who spins,' it came to mean the unmarried women of a family, who did the spinning for the household.

The following are instances of words which have changed in their spelling since the time of Shakespeare.

Old Spelling.	*Modern Spelling.*
Parle	Parley.
Porpentine	Porcupine.
Enginer, pioner	Engineer, pioneer.
Assay	Essay.
Theorick, practick	Theory, practice.

The following words have changed in their pronunciation:—
Rome was pronounced *room*.

'Now is it Rome indeed, and room enough.'
—Julius Cæsar.

Character was pronounced with the accent on the second syllable.

'I say without character fame lives long.'
—Richard III.

Contrary is also pronounced with the accent on the second syllable.

'Standing on slippers (which his nimble haste
Had falsely thrust upon contrary feet)."
—King John.

6. Explain, as to the first class of a senior school, the different forms which the object of a sentence may take: and write a short paragraph in illustration, which shall contain each of them.

The direct object of a sentence may be:—
(1) A noun, as
I opened *the door* to my father.
(2) A word used as a noun.
(*a*) An adjective, as
We love *the good*.
(*b*) A pronoun, as
I saw *you* yesterday.
(3) A verb in the infinitive mood. If it be the infinitive mood of a transitive verb, the object of the sentence is still further extended by the addition of the object of the verb, as
I like *to skate*.
He requested *to see my father*.
(4) A verbal noun or gerund, with or without an object of the gerund, as
My brother teaches *writing*.
I like *reading good books*.
(5) A sentence, as
I know *that you will be angry with me*.

Some kinds of verbs require a second or indirect object to complete their full sense, as
I have brought *you the newspaper*.
Here *the newspaper* is the direct object, as it is directly affected by the action of bringing, and *you* the indirect object, as it is less directly affected by that action.

The verbs *to teach*, *to ask*, etc., take two objects, one of the person, the other of the thing taught, as
She taught me sewing.
In the passive voice, the name of the thing remains as a single object, as
I was taught *sewing* by her.

The following paragraph contains all these objects:—
When my mother took *me* to school I was asked my *name*. The master then gave *me a book*, and asked *me to read*, which I did to the best of my ability. In answer to the question whether I liked *reading*, my mother replied *that I was very fond of works of fiction*. I soon learned *to esteem my worthy master*. He encouraged *the industrious* by every means in his power, and the boy of small mental ability who did his *best* secured as much *praise* as the boy of brilliant parts, who found intellectual *labour* easy.

7. Into what classes would you divide conjunctions? With what other parts of speech would you connect and contrast them?

Conjunctions may be divided into *Co-ordinative* and *Subordinative*.

Co-ordinative Conjunctions join together sentences of equal rank, and words fulfilling the same grammatical functions in any one particular sentence. Thus they may join together two words which unitedly form a compound subject, as John *and* James are gone; two words which unitedly form a compound object, as, I will take an apple *or* a pear, etc., etc. This class of conjunction may be further subdivided into—
(*a*) *Copulative*, or simply Connective, as *and*, *also*.
(*b*) *Alternative*, as *or*, *nor*.
(*c*) *Adversative*, or contrasting, as *but*.

Subordinative Conjunctions are those which connect a subordinate to a principal sentence, as, I know *that* you are wrong; I will go *if* you desire it. *That* joins a noun sentence, and *if* an adverbial sentence to a principal sentence.

Conjunctions may be connected and contrasted with prepositions and adverbs. They differ from the former in the fact that whereas prepositions show relationships between ideas represented by single words, conjunctions show relationships between the various statements which make up a complex sentence. Thus in the sentence 'He stood *before* the door,' 'before' is a preposition, because it shows a relationship between the state of standing, represented by the single word *stood*, and the object, which is represented by the single word *door*. But in the sentence 'He came *before* I wanted him,' 'before' is a conjunction showing a relationship of time between the whole statement 'I wanted him' and the whole statement 'he came.'

Conjunctions are like adverbs because they help us to express ideas like those of *place*, *time*, *causality*, etc. The adverb, however, expresses the idea by itself, and without the help of any other word. In the case of the conjunction, it is the whole sentence that expresses the particular idea in question, the conjunction being only the link word serving to show the particular idea which has to be expressed by the whole sentence which it introduces. Thus in the sentence 'I will tell you *now*,' 'now' is an adverb of time, because by itself it tells us when the action of telling is to take place. But if we say 'I will tell you *when* I have finished my letter,' 'when' is a conjunction, because it does not by itself let us know when the action of telling is to take place, but it introduces the sentence 'I have written my letter,' which marks the time when the person is to be told.

8. With what periods in the history of our language are Spenser, Dryden, and Wordsworth connected? What is specially characteristic in the writings of each?

Spenser belongs to the Elizabethan period of English literature. His writings exhibit great poetical fancy and beautiful imagery. These qualities, however, render it somewhat difficult to read continuously very much of his great work. The reader becomes satiated with the sweetness of the verse, and is compelled to stop from mere repletion.

Dryden belongs to the Restoration period of English literature. He introduced greater polish into English metre, while at the same time retaining much of its strength. He possessed a wonderful power of reasoning in verse. In reading such works as the 'Religio Laici' and the 'Hind and the Panther,' we see how completely the poet, in presenting his chain of reasoning, triumphs over the shackles imposed on him by rhyme and rhythm.

Wordsworth belongs to the group of poets of the early part of the nineteenth century, who sought their inspiration directly from Nature and from the problems of human life. Other poets of the same period, particularly Byron, had dazzled and captivated their contemporaries with the brilliancy of their verse, but we feel in reading their productions that their characters do not belong to real everyday life. Many of Wordsworth's poems, however, will be read when Byron is neglected, because they deal with what is everlastingly true in Nature and in Man. The defect of Wordsworth's poems is that in his faithful descriptions he does not always choose what is capable of poetic treatment, and descends sometimes to the commonplace.

English Composition.

Men and Women.

Thursday, 19th December, 10 to 11.

Write a short essay on *one* of the following subjects:—

(*a*) 'Hope springs eternal in the human breast;
Man never is, but always to be blest.'

(*b*) The Japanese.

(*c*) How may the spirit of patriotism be promoted in elementary schools?

(*a*) That hopefulness is the usual condition of the human mind has been a favourite theme with poets in all ages. Despair is but incidental, and when the paroxysm of hopelessness has passed, hope resumes its normal sway. The ancient Greek myth of Pandora's box, from which issued all the evils incident to humanity, to afflict him who opened it, represented Hope as remaining at the bottom of the box, for the purpose of redressing the evils and sorrows of life. One of the most famous of German poets pictures Hope as accompanying man through life, and as being unimpaired by death. Even in the grave the hope of a future joyful reunion remains, to lessen the sorrows of those who mourn their departed ones. The power of reason distinguishes man from the brute creation; but reason, unaccompanied by Hope, would make this present life a very miserable one. Reason and experience tell us that the future is dark, and possibly has in store for us much of evil. Hope forbids us to dwell on the possibility of evil befalling us, and leads us to take brighter views of the future than we should take had we only reason to guide us. It thus inspires us with a motive for present endeavour, for were despair to maintain an unceasing hold upon us, our energies would be utterly damped. Hope lies, therefore, at the bottom of human progress. Both from the lives of individuals and of nations many instances can be cited to show how unflagging Hope in the future has enabled them to triumph over present difficulties. Nor does our disappointment when we gain the blessing hoped for, and find it is not all our imagination pictured it to be, prevent us from forming still further hopes for the future. 'Man never *is*, but always *to be* blest.' If the present disappoints us, the future may yet have something better in store for us. Reason and experience tell us that hope is oftentimes illusory, but we hug to our breast the beautiful visions with which Hope flatters us, let reason prove ever so convincingly that the future has only disappointment in store for us. To a very great extent we pass our life in illusions, but those illusions help to take off much of the bitterness of life's realities, and he who would destroy them would not be rendering a good service to humanity.

(*b*) The Japanese are in many respects the most interesting people of the Far East. Men who have only reached middle age can remember that when they were young, popular opinion in Europe classed the Japanese with their neighbours the Chinese as a people who had reached centuries ago a certain degree of civilisation, which had remained stereotyped. Like the Chinese, too, they entertained a great aversion for foreigners, and were liable to sudden outbursts of passion against people from other nations who had settled among them. But in 1868 a revolution occurred, and this put an end to the old feudal system which had proved a bar to progress in Japan. Since that time the nation has made rapid strides in civilisation. One of the immediate results of the revolution was a desire to acquire the learning and the arts of Europe. Numbers of Europeans, attracted by the prospects opened to them, went to Japan to teach the languages and industries of Europe. Of late years the demand for European instructors has lessened, as the young Japanese, who have profited by the instruction they have received, are able to impart to their countrymen what they themselves have been taught. Large numbers of young Japanese have been sent by the Government of Japan to Europe for purposes of instruction. The commerce of the country has developed to a wonderful extent. Education has become general, and the ability to read is now so widespread that Japan takes the third place amongst the nations of the world with regard to the productions of the printing-press. A representative system of government has been introduced somewhat similar to our own. The Japanese are a people of delightful manners. Their politeness is such that they have been called 'The French of the East.' They are very cleanly in their persons, kind, and affectionate. The war which lately took place between China and Japan proved the immense superiority of the Japanese over their neighbours in power of organisation, personal courage, and patriotism. The progress which has taken place in recent years warrants the conclusion that at no distant date the politics of Europe will be profoundly altered by the uprising of this new power.

(*c*) Everyone will admit that it is very desirable that the spirit of patriotism should be promoted in our elementary schools. It is, however, necessary to bear in mind in what true patriotism consists. It does not consist in applauding all our country does, right or wrong. It must always be remembered that 'Righteousness exalteth a nation,' and that disregard of the moral law by one nation in its dealings with others as surely brings its punishment as it does in the case of an individual. True patriotism would desire that our country should be as renowned for the uprightness of its dealings with less powerful nations as it is for the courage and perseverance of its children. Nor does true patriotism consist only in welcoming and aiding in the acquisition of new territories and the extension of our material wealth. A truly loving parent scrutinises the conduct of his children more rigidly than any stranger would or could do; and a truly loving son of Britain, who loves his country with a discerning love, would as ardently wish to see his country at the head of every movement which has for its object the moral and intellectual progress of humanity, as he would wish to see it victorious by land or sea. To promote a spirit of patriotism

in our schools, we should endeavour to show by reference to the past and present history of our country that it is a country worth loving, and worth defending if the need should arise. The lessons in English history should show the progress which has been made in material wealth and in freedom. Above all, the teacher should show that this immense progress has been due not only to the masses of our nation, but to the untiring exertions of individuals, who have stood up against tyranny at home, have defended us against foreign invasion, have given us the benefit of the improvements they have introduced into arts or manufactures, or have sacrificed wealth and leisure to combat crime and misery in our midst. Biographies of great Englishmen should be made a special feature of the history lessons, and the teacher should draw from them the moral that the humblest individual can do something for his country. If he can do nothing more, he can set the example of a blameless life to his neighbours. The importance of the vote entrusted to us for the election of local and Imperial governing bodies should be dwelt upon. We must impress on our scholars that this vote is a trust, for the right use of which we are accountable to the nation at large. It should always be exercised, and exercised intelligently, not following the dictates of passion or caprice. The anniversaries of great days in the history of the nation should not be allowed to pass by without recalling the events which have made those days famous. Patriotic songs should be taught, and the teacher will find that both music and words of these are better than those of many of the maudlin sentimental songs which often become popular. The teacher should also recommend to his children the reading of works which tell of the great deeds wrought by our countrymen in past times.

(*To be continued.*)

FAGIN, THE THIEF-TRAINER.

A NEGLECTED ASPECT OF EDUCATION.

BY JOHN ADAMS, M.A., B.SC.,

Rector, Free Church Training College, Aberdeen.

I.

THERE is a prevailing impression among teachers, and particularly among those concerned with what is sometimes called 'a liberal education,' that it really does not matter very much what one learns, the culture comes all the same. It is not the *what*, it is the *how*. The base utilitarian may study Euclid in order that by-and-by he may be able to estimate the cubical content of dungheaps; the embryo man of culture studies geometry in order to train his mind. The classics have no doubt some commercial and social value, but they are said to owe their commanding place in our educational system to their power as a mental discipline. The graduate may forget his Latin and his Greek, it is said, but he can never lose the culture they have left in his mind.

In the present war of conflicting subjects the main point of discussion is: Which gives the best results in culture, which is best fitted to cultivate the mind? classics, science, mathematics—each claims pre-eminence. It is left for the Herbartian to sweep aside all claims alike, and raise the preliminary question: Do any of them train the mind at all? Can the mind be trained?

Accepting, for the moment, the popular view that the mind can be trained by any subject whatever, with the limitation that certain subjects are better for training purposes than others, let us see how this thing works out. Take three men, one trained as exclusively as is possible on the classics, another on science (say biology), and the third on mathematics. To test the effect of the training a problem is set to all three—the same problem. Let it be to decipher a certain hieroglyphic inscription. There is an uneasy feeling in your minds, is there not, that somehow this is not quite fair. The mathematician and the biologist would probably at once object that this test gives the classic an unfair advantage, and when it is pointed out that the inscription is in neither Latin nor Greek, the ready reply is that it is at least in the line of language, and therefore easier for the scholar than for the others. When the problem of determining the age of a given stratum of rock is substituted, it is the classic's turn to object, and even the mathematician is not pleased. It is not a question in biology exactly, but it is more in the biologist's *line*. Tossing about for a perfectly neutral test, our eyes fall upon a chess-board, and we set our three examinees to discover how, in the minimum number of moves, to place the knight upon every square of the board. Even here there is dissatisfaction. It comes out that the classic and the biologist consider this problem to be of a mathematical character. It calls into play the same faculties as mathematics.

The result of our experiment appears to be that each of the subjects in question cultivates, not the mind in general, but in certain special directions. In other words, formal education, as it is called, is not quite so formal as it is supposed to be; it is not quite dissociated from the special subject. For when we talk about a mathematical mind, we surely do not mean exactly what we say. It cannot be seriously maintained that the mind acts in one way in mathematics and another in classics. If, then, each subject develops a special form of mind, as indicated by the terms mathematical mind, philosophical mind, scientific mind, this special form must be connected with the matter—the content of the mind.

To illustrate: Suppose the problem set to our three men is to find a lost will. Which of the three would have the best chance to succeed? The question is difficult, and not in itself important. We may be wrong in our answer; the important point is upon what principle did we proceed to our conclusion? The mathematician we have at once dismissed. The idea of a mathematician—as mathematician—finding anything that is lost is more than improbable; it is amusing. Some may be inclined to back the biologist, from the well-known methods of patient study that his science demands. But on the whole the classic would be the most likely to succeed, and that not because he had a better trained mind, but because his studies had brought to him greater acquaintance with human nature (part of his subject haughtily calls itself *Humanity*), and there is usually a good deal of human nature about the losing of a will.

Thus, if it is of importance to discover the most likely searcher, we consider the content of the minds submitted; if it is important to find the will, we send for an experienced lawyer.

It is not maintained that this lawyer has a better trained mind than our three friends, but he has a bigger and better arranged lost-will apperception-mass.

If it be true that this 'formal' education is possible, if the matter of study is only of consequence as a sort of whetstone of the mind, why do not

teachers choose pleasanter subjects than at present? We can readily see the force of an argument that condemns cricket as a complete instrument of education. It may be a capital hand-and-eye training, but a certain number of 'faculties' are left idle. There must be in-door as well as out-door education. But when the boy comes in from cricket, why call him away from his chess to study Euclid? This game is said to exercise pretty much the same faculties as mathematics. Many boys like chess and hate mathematics; why not give them what they want? The usual answer is that chess does not offer a wide enough field. The real answer is that after all chess training is only training in chess.

Is it too much to say that the same remark applies to other studies? Is it very unusual to find a man brilliant at, say, mathematics, and a dolt at all else? Is an intimate acquaintance with the classics any guarantee of intellectual power in other departments?

But perhaps the most effective argument against 'formal' education is to be found in the way in which sin, vice, and crime are treated as educational agencies.

What could call into play more of a boy's faculties than orchard-robbing? Almost all the virtues are trained in the exercise of this vice. The necessary planning demands prudence, forethought, caution. The choosing of the right moment implies careful observation, judicious estimate of character, and intelligent calculation of probabilities. The actual expedition demands the greatest courage, firmness, and self-control. Climbing the tree and seizing the fruit are only possible as the result of the most accurate adjustment of means to end. All the results aimed at in the most liberal intellectual education are here secured; no teacher is required, and the boy enjoys it. Why does not apple stealing rank with Latin and mathematics as a mental gymnastic?

Why do we hear so little of Education in Crime? We have myriads of tracts on Education *and* Crime, in which the former is generally treated as a more or less effective antidote to the latter, yet I do not chance to know any treatise on the technical training of thieves and cut-throats.* Yet, if formal education is possible, then instruction in crime ought to be educationally as important and profitable as instruction in science or classics. Indeed Crime has a very special advantage as an educational organ, since it is entirely free from professional prejudices. So much has been written of late on 'educational values' that no one can treat of science, or classics, or mathematics, or modern languages, or history, without being at once thrust into a class, and treated as a partisan.

From this taint, at least, crime is quite free. Fagin's school, as an intellectual training ground, is virgin soil for the educationist, who can there test his theories without fear of his results being complicated by the accumulated prejudices of scores of predecessors. It is no doubt humiliating to have to turn to a mere novel instead of to a large, closely-printed and respectably dull treatise, but education in crime is as yet only in the natural history stage of development. Dickens merely describes, he does not explain; to a later stage belong the theories—and the dulness.

If you examine your minds at this moment, you will probably find them in a state of somewhat indignant confusion. Two ideas have been called into the field of consciousness at the same time—two ideas that have always regarded themselves as natural enemies to each other—and those two ideas have been asked to join in the friendly relation of cause and effect. As two boys, caught by the master in the very throes of war and ordered by him to shake hands, hang back scowling at each other, not otherwise stand in your minds at this moment the two ideas of crime and education.

A little analysis of your thoughts will probably show you that the underlying belief that caused this disturbance is really that crime needs no teaching. There is a prevailing opinion that crime is easily attained; that anybody can be a criminal. If some speakers and writers are to be believed, the difficulty is all the other way, and the great trouble of an ordinary man's life is to keep from becoming a criminal. Now while it is quite easy for any of us to stumble clumsily into crime, it does not at all follow that we have any claim to rank among criminals—real criminals, professional criminals. We all occasionally blunder into a syllogism, but we are not on that account arrogant enough to call ourselves logicians. To be a successful criminal requires as careful training as to be a successful judge, and if we wish to investigate the educational value of crime, we must study it under the most favourable circumstances, in one of the best schools.

We cannot more fitly introduce Fagin's school than by a report supposed to have been written by an emancipated inspector of schools, who has enlightened views on the relation between education and crime. Such a man, regarding skilful crime as the immediate object of the school, with mental training as a secondary and inevitable result, might well produce some such report as the following:—

'I have again to call attention to the unsuitability of the school-premises. Only a low view of crime can be formed in a cellar. If this matter is not attended to, it will be necessary, next year, to recommend a substantial reduction under Art. Onety-One. The organisation and discipline are, on the whole, excellent, and the Higher Grant is recommended, though the teachers should be informed that toasting-forks and frying-pans are not suitable instruments for maintaining order. The tone of the school is excellent, and reflects great credit on the headmaster, Mr. Fagin, whose enthusiasm cannot fail to have an excellent effect in stimulating his pupils. The general character of the instruction in the ordinary subjects is creditable. The text-books used, however, are of a low order, and are now out of date; they must be changed if the higher grant is to be recommended next year. There is a lack, too, of suitable occupation for the new pupils while the old ones are at their usual work. This must be at once attended to. The physical exercises were gone through with precision and heartiness. Object lessons are well attended to, one of the senior pupil teachers, William Sikes, deserving special praise for his effective lesson on the loading of a pistol, and the connection between a loaded pistol and holding one's tongue.'

Have you imagination enough to picture Mr. Fagin sitting by his fireside, a saveloy in one hand and this report in the other, reading with the palpitating interest that the works of Her Majesty's Inspectors always command.

'*Premises*,' he mutters; 'same old story. Good thing that isn't my lay. *Excellent*—ha!—*on the whole*—as usual. *Forks and frying-pans!* What eyes those

* In Sparta larceny was not taught as a means of culture, but with a distinctly utilitarian end in relation to the Helots.

inspectors have got! Must keep them out of sight next time he comes round. *Great credit*—come, that's something like—*enthusiasm—stimulating*—now that's what I call—hillo! What's this about text-books? *I* didn't make the text-books; that's the publisher's look-out. They're the easiest I can find.'

Here we may be permitted to interrupt Fagin, first of all, to quote from Dickens the passage referring to the text-books, and then to show that, as is not seldom the case, the teacher, and not the publisher, was to blame for whatever was wrong.

Oliver is described as turning over the leaves of a book that has been left to enliven his solitude on the eve of a crime into which he is to be dragged.

He turned over the leaves carelessly at first, but, lighting on a passage which attracted his attention, he soon became intent upon the volume. It was a history of the lives and trials of great criminals, and the pages were soiled and thumbed with use. Here he read of dreadful crimes that made the blood run cold; of secret murders that had been committed by the lonely wayside; of bodies hidden from the eye of man in deep pits and wells, which would not keep them down, deep as they were, but had yielded them up at last, after many years, and so maddened the murderers with the sight that, in their horror, they had confessed their guilt, and yelled for the gibbet to end their agony. Here, too, he read of men who, lying in their beds at dead of night, had been tempted (so they said) and led on by their own bad thoughts to such dreadful bloodshed as it made the flesh creep, and the limbs quail to think of. The terrible descriptions were so real and vivid that the sallow pages seemed to turn red with gore, and the words upon them to be sounded in his ears as if they were whispered in hollow murmurs by the spirits of the dead.

This is obviously not the sort of literature to encourage enterprise in crime. Had Fagin been able to spare time from his other professional work to edit this manual, you may be sure the blue pencil would have been unflinchingly used. Those totally uncalled-for confessions would cease to mar the charm of the narrative; the gibbet would be carefully excised; those pits and wells would have been seen to and made decently corpse-tight. We are sure of this, for Fagin is clearly better than his books. Listen to his own method of story-telling:—

At other times the old man would tell them stories of robberies he had committed in his younger days, mixed up with so much that was droll and curious, that Oliver could not help laughing heartily, and showing that he was amused, in spite of all his bitter feelings.

There speaks the true teacher. There is some chance of a boy coming to something in crime with lessons like that. Yet Fagin is not the only genuine teacher in the school. The object lesson commended by the inspector is well worth reproducing in full. Not every lesson given by certificated teachers in this country has the point and finish of Mr. Sikes' effort. Addressing the trembling Oliver, who is to be forced to accompany the burglar on professional business, Bill begins:

'Come here, young 'un, and let me read you a lectur', which is as well got over at once.'

But Bill is better than his word. Most pupil teachers begin by telling the class that they are going to give a lesson, and then proceed to give a lecture. Bill does precisely the opposite; his lecture at once develops into a genuine object-lesson.

Thus addressing his new pupil, Mr. Sikes pulled off Oliver's cap and threw it into a corner, and then, taking him by the shoulder, sat himself down by the table, and stood the boy in front of him.

'Now, first, do you know wot this is?' inquired Sikes, taking up a pocket-pistol which lay on the table.

Oliver replied in the affirmative.

'Well, then, look here,' continued Sikes; 'this is powder; that ere's a bullet, and this is a little bit of a old hat for waddin'.'

Oliver murmured his comprehension of the different bodies referred to, and Mr. Sikes proceeded to load the pistol with great nicety and deliberation.

'Now it's loaded,' said Mr. Sikes when he had finished.

'Yes, I see it is, sir,' replied Oliver.

'Well,' said the robber, grasping Oliver's wrist, and putting the barrel so close to his temple that they touched, at which moment the boy could not repress a start; 'if you speak a word when you're out-o'-doors with me, except when I speak to you, that loading will be in your head without notice. So if you *do* make up your mind to speak without leave, say your prayers first.'

Having bestowed a scowl upon the object of this warning, to increase its effect, Mr. Sikes continued:

'As near as I know, there isn't anybody as would be asking very partickler arter you, if you *was* disposed of; so I needn't take this devil-and-all of trouble to explain matters to you, if it wasn't for your own good. D'ye hear me?'

Matter apart, this lesson would probably knock an *excellent* out of any inspector.

(*To be continued.*)

A RECENT INSPECTION.

MIXED SCHOOL. AVERAGE ATTENDANCE 300.

STANDARD I.

Arithmetic.

709	936	750	908
96	58	237	75
580	746		
43	92	513	833
672	870		
2100	2702		

Elementary Science.

(Course of thirty lessons taken from Murche's 'Lessons in Elementary Science.')

Inspector questioned on plastic substances generally as follows:—New buildings close to school. What built of? (Bricks.) Where are bricks obtained? (Clay burnt.) Where does clay come from? (Earth.) What called? (Mineral.) Name any other mineral? (Stone, iron, etc.) Is a potato a mineral? (No.) Why? (Lives and grows in the earth.) What done to clay when got out of the ground? (Mixed with water.) Notice any change? (Yes.) What change? (Becomes softer.) Suppose you wanted to make little men, or cups and saucers out of clay, would you use dry or moist clay? (Moist.) Why? (Because it is plastic.) What meant by plastic? (Can be changed into any shape and will remain that shape.) Pour water on moist clay. Result? (Flows off.) Why? (Because it is not porous.) Name any use for moist clay? (Lining sides of reservoirs, canals, &c., to prevent water from flowing away.) Notice windows of class-room. Frame hard. Glass hard. How is the glass kept firm in the frame? (By putty.) Child called to window to show where the putty was. Asked to tell whether hard or soft. How then could it be used to help to put pane of glass in? Elicited that it was soft when used, but became hard by exposure to the air. What is putty made of? (Whiting and linseed oil.) What is whiting? (Powdered chalk mixed with water.) What does linseed oil come from? (Seeds of flax plant.) Inspector then questioned on the differences between solids and liquids, introducing it by asking a boy whether, if he told him to fetch some water, he could carry it in his hand? (No.) Why? (Because it would flow away.) Name any other substance that you could not carry in your hand? (Oil, vinegar, milk.) What are these called? (Liquids.) Name anything you could carry in your hand? (Slate, stone, coal, salt, etc.) What called? (Solids.) Children at Blackpool play with sand, piling it up; could they do so with water? (No.) Why? (Because it always has a level surface.)

Singing.

d s m r d s l s l t l s d' d d'
m s d r m f s l t d' s d m s d

|d : — |d :d |d :d |d : — |d : — ‖

Grammar.

Inspector read a few lines, and asked the children to count the nouns in the passage read; then one was selected to call out the nouns, in each case being asked *why* the word was a noun.

STANDARD II.

Dictation.

The dictation chosen was from Nelson's 'New Royal Readers,' p. 83, par. 1.

Arithmetic.

79,030	93,078	8)71,023
48,064	680	8,877 + 7
30,966	7,446,240	
	558,468	
	63,203,040	

Problem given for first time, with the intimation that it would be expected to be accurately worked by the greater part of the scholars in order that the higher grant may be earned—

Problem.—If there were 60 lines of soldiers, and 81 soldiers in each line, how many soldiers were there altogether?

Ans. 4,860.

Grammar.

Short passage read by inspector. Children asked to tell how many nouns in that passage, then how many verbs. In every case they were asked, when telling the nouns, *why* the word was a noun, and similarly for the verbs.

Elementary Science.

This being the first year that Elementary Science was taken as a class subject, the scholars in Standard II. were taught from Murche's Lessons for Standard I., so as to prepare better for the course for Standard III. next year. The inspector chose the lessons on 'coal' and 'coal mining.' He began by asking the children what the large wheels they could see across the fields so high in the air, were for. (To wind coal up from the mine.) Name of place where coal is obtained? (Coal-mine.) What is the place called where cages go up and down? (Shaft.) Imagine going down the shaft with me. How far might we have to go to get to the bottom? (From 150 ft. to 1800 ft.) What notice at bottom? (Very dark.) What see? (Men with lamps.) Why lamps? Why not gas or oil lamps? (For fear of explosion.) Explosion of what? (Coal gas.) Why no fear of explosion with safety-lamps? (Wire-gauze round the light will not allow flame inside to get to coal gas outside.) Now look and tell me what you see besides? (Long galleries or passages.) What in them? (Coal-tubs moving on tram lines.) Where come from? (Where the coal is being got.) Follow on to where the coal is being got. See a man at work. What is he doing? (Using a pick and getting coal.) What called? (Hewer.) What place called where he is striking? (Coal-seam.) Is there any danger besides from gas? (Yes.) What? (Roof falling.) How does miner work then? (Leaves pillars of coal to prop roof up.) Suppose they have got all the coal in the seam, are these pillars left? (No.) How got? (Roof propped well with timber, then coal got that was left.) What do you notice about all the workers? (Black faces and hands.) Why? (Coal will soil the hands or face if touched.) The air seems as fresh in the mine as above ground. How does it get down? (By shaft.) Coming out of mine we notice some carts carrying very small coal. Where going? (Factories.) What used for? (For boilers to make steam to drive machinery.) What used in house for? (Giving heat and cooking.) Suppose I turn this tap—a gas tap—what do you notice? (Bad smell.) Apply a light—what see? (Flame.) What is burning? (Gas.) Where come from? (Gas works.) What made from? (Coal.) Is it same kind of coal as used in houses? (No. Cannel coal.) Inspector closed with a few remarks to children on the sympathy they ought to have with miners in their dangerous work, especially considering the serious accidents recorded recently as occurring in coal mines.

Singing.

d s f m d s l t d' m s f m
r m s f m d' m d' s d r m d

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STANDARD III.

Arithmetic.

(*Scholars were told that they could work any four sums on card.*)

Boys only. (1) Find the product of 79,068 and 308.

Ans. 24,352,944.

(2) Add together £17,096 12s. 1½d.; £956 18s. 0¾d.; £17 0s. 10½d.; £8,080 7s. 4½d.; seventeen shillings and a farthing, and one hundred thousand pounds and a penny.

Ans. £126,151 15s. 6½d.

(3) Find the difference between two thousand pounds ten shillings and a farthing, and twenty thousand and ten pounds.

Ans. £18,009 9s. 11¾d.

(4) A man gained £5 in 4 days. The first day he gained 1s. 3d., the second day 1s. 6d., the third day 2s. 6d.; what did he gain the fourth day? Ans. £4 14s. 9d.

Boys only. (1) Multiply 19,068 by 78. Ans. 1,487,304.

(2) Find the quotient of 74,096 and 74. Ans. 1,001 + 22.

(3) Tom had 11 marbles less than Henry, and Henry had 19 marbles less than John; John had 570 marbles. How many had they altogether? Ans. 1,661.

(4) Divide the half of 8,080 by 5. Ans. 808.

Boys only. (1) Divide 303,090 by 307. Ans. 987 + 81.

(2) From £30,010 10s. 10½d. take £707 19s. 11½d.

Ans. £29,302 10s. 10¾d.

(3) Find the sum of £107 10s. 2½d.; £93,060 12s. 7½d.; sixteen shillings and three half-pence; £49 10s. 1d.; £108,008 19s. 11½d., and three hundred pounds and three pence.

Ans. £201,527 9s. 2½d.

(4) Three sheep cost seventeen pounds six shillings and fivepence halfpenny. The first cost £8 9s. 6d., the second cost £5 3s. 7½d. What did the third cost? Ans. £3 13s. 4d.

Boys only. (1) From the fourth part of 6,600, take the half of 3,000. Ans. 150.

(2) Multiply 38,096 by 74. Ans. 2,819,104.

(3) Add together £17,026 19s. 4½d.; £109 19s. 6½d.; £3,070 16s. 10¾d.; twenty thousand and three pounds, and two pounds and a penny. Ans. £40,212 15s. 10½d.

(4) A man had three five pound notes. He spent 13s. 6d., and then added two half-crowns to his money. How much had he then?

Ans. £14 11s. 6d.

Boys only. (1) Divide the half of a million by 37.

Ans. 13,513 + 19.

(2) Multiply 76,094 by 95. Ans. 7,228,930.

(3) Find the difference between £27,010 17s. 3¼d. and twenty thousand and nine pounds eighteen shillings and three farthings.

Ans. £7,000 19s. 2½d.

(4) Three boys saved 240 apples each, and divided them amongst 20 boys. How many did each boy get? Ans. 36.

Girls only. (1) Divide 36,092 by 7. Ans. 5,156.

(2) Find the sum of two shillings and a farthing, £17,090 10s. 6d., £1,803 12s. 7½d., £97 16s. 3½d., and seventeen pounds and fourpence three-farthings. Ans. £19,009 18s. 10d.

(3) Find the product of 67,408 and 86. Ans. 5,797,088.

(4) A man had one hundred pounds. He bought 26 sheep at £2 each, and gave one quarter of his money away. How much had he left? Ans. £23.

Girls only. (1) Take fivepence halfpenny from one hundred pounds one shilling. Ans. £100 0s. 6½d.

(2) Divide 71,031 by 8. Ans. 8,878 + 7.

(3) Add together one thousand pounds and a halfpenny, £21,009 16s. 11½d., £79 10s. 3¾d., seventeen shillings and ninepence farthing, and £19,960 19s. 10½d. Ans. £42,051 4s. 11d.

(4) A dressmaker made four dresses. One dress cost £2 10s. 0d., another £2 3s. 9d., the third £2 16s. 0d., and the whole bill was ten pounds. What did the fourth dress cost? Ans. £2 10s. 3d.

Girls only. (1) From the fourth part of 10,000 take the half 2,076. Ans. 1,462.

2) Divide 117,560 by 12. Ans. 9,796 + 8.

3) Find the sum of £3,090 16s. 10½d., £127,009 19s. 7½d., £178 7½d., £9 0s. 9¾d., and three half-crowns.
Ans. £130,128 2s. 5d.

4) A man had half a sovereign. He bought 24 oranges at a penny each, and ninepennyworth of nuts at eighteen for a penny. How much change had he? Ans. 7s. 3d.

Girls only. (1) Divide 109,887 by 11. Ans. 9,989 + 8.

2) Find the sum of £110 0s. 10½d., £70,006 19s. 6½d., £1,000 19s. 9½d., £18 0s. 8½d., and four half-sovereigns.
Ans. £80,038 0s 11d.

3) Find the difference between seventeen shillings and a half-penny, and £17,002 16s. 1d. Ans. £17,001 19s. 0½.

4) A man left one thousand pounds to his three daughters. To the first he left £100, to the second four hundred and four pounds seventeen shillings. What was left to the third daughter?
Ans. £495 10s. 0d.

Elementary Science.

How many kinds of matter are there? (Three.) Name them? (Solids, liquids, and gases.) What is matter made up of? (Small particles.) Can any one of these be changed into another? (Yes.) What change can there be? (Solid into a liquid.) Any other? (Liquid into solid.) Give an example of a solid being changed into a liquid? (Sealing-wax, dripping, butter, etc., by heating.) Any example of liquid being changed to solid? (Water being frozen to ice.) Now, where is there a gas? (In the school-room.) What is it? (Air.) Any other? (Gas in gas pipes.) Now let us see if we can tell any effect that one of these may have on another. Put some salt in water, what happens? (Salt is dissolved.) What do you mean by dissolved? (Particles of salt broken up into very small pieces.) Where do the particles of salt go? (Into the holes of the water.) What are these holes called? (Pores.) What name is given to water because it can dissolve other substances? (Solvent.) What must a solvent be? (Porous.) How can you prove that the salt is in the water? (By tasting or boiling it.) What happens if boiled? (Water passes off as steam and salt is left.) Don you know any place where that is done? (In salt districts.) Why? (To get it out of the brine.) What is brine? (Water containing salt.) When I breathe out, what do I breathe? (Air.) Is there anything in it injurious to us? (Yes, carbonic acid gas.) How could you prove that? (Room crowded with people, doors and windows shut, people would die.) Do you know anything requiring that gas which is poisonous to us? (Yes, trees and plants generally.) Do they breathe? (Yes.) What do they breathe out? (Oxygen—so useful to us) If that be so, is it healthier to live in the town or the country? (The country.) Now examine a plant—one procured from a neighbouring garden as example. How many different parts do you notice of this plant? (Three.) Names? (Root, stem, leaves.) This part is dirty with soil. Why? (Because it has been in the ground.) Name? (Root.) Name of this long part? (Stem.) What are these on the stem? (Leaves.) If this plant had been allowed to grow in the garden, what would have grown on the stem? (Flowers.) What follow them? (Fruit.) If fruit is allowed to become ripe, what are there inside? (Seeds.) What work does the root do for the plant in the ground? (Finds food.) How does it get it? (By sucking up water out of the soil.) Then is the water food? (No.) Then where is the food? (Dissolved in the water.) What similar example has been mentioned in this little chat we have had? (Salt being dissolved in the water.) Would water keep this plant alive if it were taken out of the soil? (No.) What are these little threads which you see so many of? (Root hairs.) Then what kind of a root is this? (Fibrous root.) How long would this plant live? (Only one season.) Do any plants live longer? (Yes.) What kind are they? (Those with fleshy roots.) Why? (Because the root contains food for the plant enabling it to live during the winter.) What use is this stem? (To bear the flowers and leaves.) What of what use are the leaves? (To breathe air in and out.) What is the air required for? (To change the sap into proper food for the plant.) What do you children love to find just now in the fields? (Flowers.) What is that part called which joins the flowers to the stem? (Flower stalk.) Outer cup? (Calyx.) Its leaves? (Sepals.) Are they always same number in every flower? (No.) How are these sepals in a bud? (Close together.) Why? (To protect the parts inside from the weather.) Now name the next part inside. (Corolla.) What are its leaves called? (Petals.) What are the long slender stalks inside the corolla called? (Stamens.) How many? (Six.) What are the knobs on the top of the stamens called? (Anthers.) Is there anything in them? (Yes—pollen.) The Inspector led on then to the pistil, ovary, and ovules, and finally closed an interesting examination by remarking how beautiful the earth was just now with its carpet of flowers.

Singing.

d m d s d d' t l s d' ta
l s fe s f m d d' m s d

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| d :d.d :d.d | d : — :d ‖

Ear Tests.—m r d; s f m; s fe s; d' t l; m f s.

STANDARD IV.

Arithmetic.

Boys only.—
(1) Divide £72 13s. 7½d. by 72. Ans. £1 0s. 2¼d. + 6.

(2) Multiply £137 12s. 9¾d. by 68. Ans. £9,359 11s. 3d.

(3) Reduce 72 galls. 3 qts. 1 pint to half-pints. Ans. 1,166.

(4) A father spent half of his money, gave 17s. 6d. away, and had 17s. 6d. left, how much had he at first? Ans. £3 10s. 0d.

Boys only. (1) Multiply £709 16s. 5½d. by 31.
Ans. £22,004 10s. 2½d.

(2) Reduce 8,008 inches to yards. Ans. 222 yds. 1 ft. 4 ins.

(3) Divide £130,007 10s. 9½d. by 65.
Ans. £2,000 2s. 3¾d. + 22.

(4) A man bought a load of coal weighing 2 tons 5 cwts. for £1 10s. 0d. and sold it in bags each containing 1 cwt. at 9½d. per bag, what did he gain? Ans. 5s. 7½d.

Girls only. (1) Multiply £172 16s. 11½d. by 365.
Ans. £63,089 2s. 2½d.

(2) Divide £50 12s. 9½d. by 76. Ans. 13s. 3¾d. + 49.

(3) Find the cost of 1½ cwts. of sugar at 2d. per lb.
Ans. £1 8s. 0d.

(4) A barrel of beer containing 18 gallons was bought for a guinea and sold at 4d. per quart, how much profit was made?
Ans. 3s.

Girls only. (1) Multiply £56 12s. 5½d. by 95.
Ans. £5,379 3s. 6½d.

(2) Divide £37 16s. 9½d. by 65. Ans. 11s. 7½d. + 55.

(3) How many quarter-pints of beer are there in a barrel containing 36 gallons? Ans. 1,152.

(4) Find the cost of 110 yards of cloth at ¼d. an inch.
Ans. £8 5s. 0d.

Girls only. (1) Multiply £172 13s. 6¾d. by 107.
Ans. £18,476 11s. 2¼d.

(2) Divide £136 19s. 2¼d. by 196. Ans. 13s. 11½d. + 161.

(3) Reduce 17 yrs. 36 wks. 5 days to minutes (52 wks. = 1 yr.).
Ans. 9,280,800 mins.

(4) How many parcels each weighing 3 qrs. 10 lbs. can be made out of 4 cwts. 22 lbs.? Ans. 5 parcels.

Girls only. (1) Multiply the half of £170 10s. 6½d. by 12.
Ans. £1,023 3s. 3d.

(2) Divide £3,927 18s. 3½d. by 396. Ans. £9 18s. 4½d. + 85.

(3) Reduce 3 bus. 3 pks. 1 gal. 2 qts. to quarter pints.
Ans. 1,008.

(4) A family consume 1½ quarts of milk daily, the milk costing 3d. per quart. They paid a milk bill of £1 11s. 6d. How many weeks had they occupied in consuming the milk? Ans. 12 wks.

Girls only. (1) Divide £4,683 17s. 11½d. by 83.
Ans. £56 8s. 7¾d. + 17.

(2) How many yards in 99,000 inches? Ans. 2,750 yds.

(3) What will ninety-three houses cost at one thousand and five pounds fifteen shillings and sixpence each?
Ans. £93,537 1s. 6d.

(4) Two coaches start in the same direction at half-past nine in the morning, one goes 8½ and the other 9 miles an hour; how far will they be apart at half-past four? Ans. 3½ miles.

Boys only. (1) Multiply £35,096 18s. 11½d. by 38.
Ans. £1,333,684 0s. 5d.

(2) Reduce 3 tons 17 cwts. 3 qrs. 16 lbs. to half-pounds.
Ans. 17,448.

(3) Find the fifty-seventh part of two thousand seven hundred and thirty-seven pounds ten shillings and tenpence halfpenny.
Ans. £48 0s. 6½d.

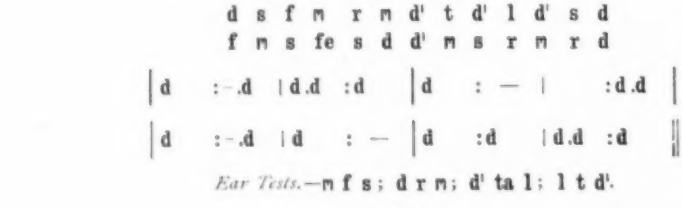
(4) A man walks 14,550 yards and takes a pace of 30 inches at every step, how many paces has he walked? Ans. 17,460 paces.

Geography.

(*Scotland, Ireland, and B. N. America.*)

What possession have we in North America? (Dominion of Canada.) What other name is given to it? (B. N. America.) Capital? (Ottawa.) What kind of surface has it generally? (Flat.) What name is given to the great plains? (Prairies.) Where is the country mountainous? (West.) Name of chief range? (Rocky Mountains.) Chief peaks? (Hooker, Brown, and Murchison.) Which way does the range extend? (N. to S.) Then which way do the rivers run which rise in the range? (E. or W.) Name one that does not run very far in either of these directions. (Mackenzie.) Name one flowing west. (Fraser.) Into what ocean does it flow? (Pacific.) Name a river running east. (Saskatchewan.) Where does it empty itself? (Lake Winnipeg.) What countries does it drain? (N.W. Territory and Manitoba.) What kind of climate has Winnipeg? (Extreme.) Why? (Centre of continent a long way from sea.) What is Manitoba noted for? (Corn growing.) Now that corn is so cheap, what other branch of farming have they turned their attention to? (Cattle rearing.) Where is cattle rearing mostly carried on? (N.W. Territory.) Name one of chief centres for it. (Calgary.) If we enter Canada from the east what attracts our attention first? (River St. Lawrence.) Follow up the river, what large town should we see first? (Quebec.) Would you notice anything about its appearance? (Stands on a high rock.) What name is often given to it? (Gibraltar of Canada.) What kind of people chiefly live in Quebec? (French Canadians.) Next town? (Three Rivers.) Next? (Montreal.) What about its position? (On an island.) What natural feature would you notice afterwards in following the river up towards its source? (Lake Ontario.) Towns on it? (Kingston, Toronto, and Hamilton.) Any more lakes? (Yes.) Which next? (Erie.) Would you see anything particularly striking before coming to Lake Erie? (Yes, Niagara Falls.) Next lake? (Huron.) Next? (Michigan.) Next? (Lake Superior.) What found round Lake Superior? (Copper.) Name some seaports in Canada. (Halifax, Sydney, Victoria, and New Westminster.) What are the chief productions of this large country? (Timber, corn, cattle, petroleum, furs, hides, gold, fish, copper.) What are its chief industries? (Lumbering, corn growing, cattle-rearing, mining, hunting, fishing.) What other country have you been learning about? (Scotland.) One part of Scotland is very thinly inhabited, which is it? (North.) What is it called? (Highlands.) What is the other part called? (Lowlands.) What are the chief industries of Scotland? (Manufacturing woollen goods, cotton goods, iron goods, linen, and sail cloth, ship building, sugar refining, fishing, and mining.) Which is the largest manufacturing town? (Glasgow.) On what river? (Clyde.) Name some other towns on the river. (Port Glasgow, Greenock, Dumbarton, Lanark.) What name is often given in Scotland to the mouths of rivers? (Firth.) Where are Ayr? (On west coast near Firth of Clyde); Dundee? (Firth of Tay); Aberdeen? (On mouth of Dee, East of Scotland.) Where is Kingstown? (On Dublin Bay, E. of Ireland.) Name a large town near it. (Dublin.) Where is Limerick? (On Shannon, W. of Ireland.) Name lakes drained by Shannon. (Allen, Ree, and Derg.)

Music.



Ear Tests.—m f s; d r m; d' ta l; l t d'.

Dictation.

The following words occurred:—Sea-voyage, completely, prolong d, disease, cure, rapid, increase, London, Edinburgh, New York, Liverpool, illness, almost, risk, hopeless.

STANDARD V.

Arithmetic.

Boys only. (1) Find the value of 1,728 articles at 4s. 6d. each.
Ans. £388 16s. 0d.

(2) If a bale of cotton weighs 172 lbs., find the weight in tons, cwts., etc., of 23 such bales. Ans. 1 ton 15 cwts. 1 qr. 8 lbs.

(3) If 22 men earn £42 1s. 0d., how many men would earn £420 10s. 0d.? Ans. 220 men.

(4) If a pole was 4 ft. 8 in. out of the ground, and ⅓ of its length under the ground, find the whole length of the pole. Ans. 7 ft.

Boys only. (1) Find the cost of 308 articles at £1 17s. 10½d. each. Ans. £583 5s. 6d.

(2) If one soldier can eat 1 lb. 9 ozs. of beef in 3 days, how much can 912 soldiers eat in the same time?
Ans. 12 cwts. 2 qrs. 25 lbs.

(3) A bucket brings up 16 pints of water each time. How many times would it have to go down to fetch up 96 gallons. Ans. 48.

(4) Work the following bill:—750 envelopes at 7½d. per 100, 208 halfpenny books, 78 dozen pencils at 9d. per dozen, 8 gallons of ink at 3d. per pint, and 6 gross of pens at 6 for ½d.
Answers. 4s. 8¼d.; 8s 8d.; £2 18s. 6.; 16s. 0d.; 6s. 0d.;
total £4 13s. 10½d.

Boys only. (1) If 45 men did a piece of work in 15 days, how long would it take 75 men? Ans. 9 days.

(2) $(\frac{3}{10} - \frac{1}{5}) + (\frac{5}{6} + \frac{7}{8})$. Ans. $1\frac{97}{120}$.

(3) Work the following bill:—14½ lbs. of beef at 8d. per lb.; 8¾ lbs. of mutton at 6d. per lb.; 3 legs of mutton, each weighing 10½ lbs., at 9½d. per lb.; 3¾ lbs. at 2s. 6d. per lb.; 5 lbs. 9 ozs. of suet at 8d. per lb.
Answers. 9s. 8d.; 4s. 4½d.; £1 4s. 11½d.; 9s. 4½d.; 3s. 8½d.
Total £2 12s. 0¾d.

(4) 6 casks of tobacco, each weighing 2 cwts. 1 qr., at £7 per qr.
Ans. £378.

Boys only. (1) Work the following bill:—17½ lbs. at 5d. per lb., 35 lbs. at 1s. 10½d. per lb., 201 hat pegs at 7s. 6d. per dozen, 35 yards at 1s. 0½d. per yard, 27½ yards at 5d. per yard.
Answers. 7s. 3½d.; £3 5s. 7½d.; £6 5s. 7½d.; £1 16s. 5½d.,
11s. 5½d. Total £12 6s. 5½d.

(2) If 34 families get 34 tons 17 cwts. of coals, what does each family get? Ans. 1 ton 0 cwt. 2 qrs.

(3) If I give Tom ⅓ of my money, Harry $\frac{7}{17}$, and James ¼, and have 2s. 6d. for myself, what had I at first? Ans. £1.

(4) Find the price of 216 tons of coal at 9s. 7½d. per ton.
Ans. £103 14s. 6d.

Girls only. (1) If an engine consumes on an average 1¾ tons daily, how long would it be in consuming 147 tons?
Ans. 84 days.

(2) Add $\frac{5}{8}$ and ¼, and subtract $\frac{3}{4}$. Ans. $\frac{1}{8}$.

(3) 15 bonnets at 3s. 7½d. each; 17 pairs at 1s. 5½d. per pair; 160 yds. at 4s. 6d. per doz.; 17 yds. of calico at 9½d. per yd.
Answers. £2 14s. 4½d.; £1 4s. 9½d.; £3; 13s. 5½d.
Total £7 12s. 7½d.

(4) Find the cost of 265 dresses at £1 3s. 7¾d. each.
Ans. £313 6s. 1¾d.

Girls only. (1) I divide my money, giving ⅓ to Jane, $\frac{7}{18}$ to Ann, $\frac{1}{36}$ to Mary, and have 3s. 6d. for myself. What had I at first?
Ans. 18s.

(2) If a man earns £382 10s. 0d. in 216 weeks, how much would he earn in 1½ years? (Reckon 52 weeks to a year.)
Ans. £138 2s. 6d.

(3) 17 lbs. of lard at 7½d. per lb.; 13 lbs. of butter at 1s. 2d. per lb.; 12 gallons of vinegar at 2½d. per pint; 300 eggs at 2½d. per dozen. Answers. 10s. 7½d.; 15s. 2d.; £1; 5s. 2½d.
Total £2 11s. 0d.

(4) 718 articles at 1s. 10¾d. each. Ans. £68 1s. 2½d.

STANDARDS V. & VI. GROUPED.

Geography.

(British Possessions taught.)

What Geography have you been learning? (British possessions.) Name some of our largest colonies. (India, South Africa, Canada, Australia.) Which is the warmest part of the world? (The Tropics.) Name any of our possessions in the Tropics. (Jamaica, British Honduras, British Guiana, India, North Australia, etc.) Name some of the productions you would expect from a tropical country. (Tea, rice, cotton, sugar, spices, indigo, sago, tapioca, arrowroot, etc.) What are the productions of India? (Tea, rice, cotton, silk, indigo, opium, spices, teak, and ebony.woods.) Where are the West Indies? (Between N. and S. America.) Which island lies nearest to S. America? (Trinidad.) Name some islands in the West Indies belonging to England. (Bahamas, Jamaica, Antigua, St. Kitt's, Grenada, Barbadoes, Trinidad.) Which most important? (Jamaica.) Towns? (Kingston and Spanish Town.) Productions of Jamaica? (Sugar, rum, molasses, cotton, coffee, and tobacco.) Where is Hong Kong? (Off the coast of China, mouth of Canton R.) Where is Singapore? (South of Malay Peninsula.) What is there peculiar about the rainfall in the Tropics? Nearly all falls at one period of the year.) What is the result? (Many places suffer from drought, and rivers are torrents in rainy season and nearly dry in dry season.) What does Australia suffer from? (Drought.)

Metric System.

Why called the Metric System? (Because all the measurements depend on metre.) What is a metre? (39·3708 inches.) How much is a kilometre? (1000 metres or $\frac{5}{8}$ of an English mile.) Why is the Metric System preferable to our own? (Because all its tables are multiples or sub-multiples of 10.) What name is given to the system because of that? (Decimal System.) What is the unit for weight? (Gramme.) Measurement of areas? (Are.) Cubical measurement? (Stère.) Volume or capacity? (Litre.) How many grammes in a dekagramme? (10.) Hectogramme? (100.) Kilogramme? (1000.) In 7689 grammes, how many dekagrammes? (768·9.) How many hectogrammes? (76·89.) How many kilogrammes? (7·689.)

Music.

d : —	m :-.f	s :d	l :-.t	d' :s	m :f
s :m	d' :t.l	s.f :m	r :d		

d s f m r d m s ˢd m s r
m r s ᵐd m r d s, t, r d

Ear Tests.—m f r d; s l s d; d f m r; s m r d.

Grammar.

Sentence written on board:—'In the early morning the General led his men up to the plain that lay beneath the town.'

What kind of sentence? (Complex.) Why? (Because it contains one principal and one subordinate sentence.) Which is the subordinate sentence? ('That lay beneath the town.') What kind of clause is it? (Adjective.) Why? Because it describes or points out 'plain.') Subject of principal sentence? ('The general.') Predicate. ('Led.') Any object? (Yes.) What is it? ('His men.') Where does the phrase 'up to the plain' go? (In the extension of the predicate, showing place.) Part of speech of 'early?' (Adj.) Suppose the sentence began 'Early in the morning,' what part of speech would 'early' be then? (Adverb.) Why? (Because it would tell *when* the general led his men.) Part of speech of 'that'? (Rel. Pro.) What does it relate to? (Plain.) Case of 'that'? (Nom. to 'lay.') What part of speech can 'that' be beside rel. pro.? (Adjective.) Any other? (Conjunction.)

STANDARD VI.

Arithmetic.

Boys only. (1) Find the simple interest on £827 10s. 0d. for 8 months at 3½ per cent. Ans. £19 6s. 2d.

(2) $3 + \frac{6}{7} + \frac{3}{8} - \frac{1}{56}$. Ans. $3\frac{109}{392}$.

(3) 51415·36 ÷ ·009052. Ans. 5680000.

(4) How many tiles, 4½ inches long and 3½ inches broad, would be required to pave a floor 14 ft. long and 9 ft. broad?
Ans. 1152 tiles.

Boys only. (1) How many half-pound packets of tea can be made from 6 chests of tea, each containing 1 cwt. 1 qr? Ans. 1680.

2. The length of a field is 3 miles and the breadth 6 furlongs. Find the area of the field, and how many minutes it would take a horse to trot round it at the rate of 10 miles an hour.
Ans. 6,969,600 sq. yds., and 45 min.

3. Find the value of ·0625 of a ton + ·0065 of a cwt. + ·75 of a qr. + ·63 of a lb.
Ans. 1 cwt. 1 qr. 22 lbs. 5 ozs. 11 drs. ·648.

(4) Take the product of $\frac{1}{13}$ and $2\frac{1}{10}$ from the product of $\frac{3}{7}$ and $8\frac{1}{6}$.
Ans. $3\frac{13}{18}$.

Boys only. (1) Find the amount of £633 for 2 years at £3 6s. 8d. per cent. Ans. £675 4s. 0d.

(2) A certain number of bags of corn would feed 30 horses for 45 weeks. How long would they last 20 horses?
Ans. 67½ weeks.

(3) A man owns property worth £9,336. He gave $\frac{7}{6}$ to his wife, $\frac{1}{8}$ to each of his three sons, and the rest to a hospital. How much was left to the hospital? Ans. £466 16s. 0d.

(4) Find the value of ·003125 of £1. Ans. ¾d.

Girls only. (1) If a halfpenny measures an inch across, what value of halfpennies placed side by side will reach a mile.
Ans. £132.

(2) If I had a cake weighing 9¾ lbs., and gave 4¼ ozs. to each of 18 children, how much had I left? Ans. 4 lbs. 15 ozs. 8 drs.

(3) Find the sum of ·35 of £5 and $\frac{1}{15}$ of £2.
Ans. £1 17s. 8d.

(4) Find the simple interest on £225 10s. 0d., for 6 years 3 months, at £3 10s. 0d. per cent. Ans. £40 6s. 6¾d.

Girls only. (1) How much coal can be bought for £50 if 38 tons cost £47 10s. 0d.? Ans. 40 tons.

(2) Add 8·0743, ·00028, 3·069, and ·0567, and divide the result by 1,000. Ans. ·01120028.

(3) Add together the greatest and least of the following fractions—$\frac{4}{5}$, $\frac{8}{11}$, $\frac{3}{4}$, and $\frac{2}{7}$. Ans. $\frac{27}{28}$.

(4) My bookcase has three shelves; ½ of my books are on one shelf, ⅓ of them on the second, and there are 45 on the third. How many books are there altogether? Ans. 108 books.

STANDARD VII.

(1) I invest £94 10s. 0d. in a 3½ per cent. stock at 108. What income do I receive from the investment? Ans. £3 5s. 7½d.

(2) Find the average weight of 10 packages, of which 3 weigh 4½ lbs. each, 5 weigh 55 lbs. each, another weighs 3½ stones, and another 30 lbs. Ans. 36¾ lbs.

(3) By selling a book for 7s. 6d. I lost 10 per cent. At what price must I sell it to gain 30 per cent.? Ans. 10s. 10d.

(4) A man buys 2½ tons of coals, and uses $\frac{1}{10}$ of this quantity daily for 14 days. Then 2¼ tons are added to the stock, and for 20 days ⅝ of a cwt. of coal is used daily. How many cwts. are left? Ans. 50½ cwt.

Composition.

Subjects given:—Boots and shoes, candles, lighthouse, umbrellas, monkeys, dolls, milk, bread, and cheese.

FORMALDEHYDE AS A DISINFECTANT.—Roux and Trillat have recently conducted experiments on disinfection in enclosed spheres of capacity varying from 70 to 1,400 cubic metres with the fumes of formic aldehyde produced by a special oxidising apparatus. Pathogenic germs can be thus destroyed when freely exposed to the aldehyde, and the dust in the air and on the walls of rooms is at the same time thoroughly sterilised. It is necessary in employing this process to avoid the escape of the aldehydic fumes because of their irritating properties, but there is no risk incurred from the formation of carbon monoxide. Dr. Bosc, who has experimented in the same direction, fully confirms these results, showing that even *Bacillus tuberculosis* can be destroyed, either in the dry or moist states, by the aldehyde fumes. He suggests that all objects which it is proposed to disinfect should be as fully exposed as possible to the action of the fumes, and that after the process of disinfection is over, free currents of air should be admitted for a quarter of an hour before the room is entered. The windows should then be left open, and after thorough ventilation for two days all trace of the formaldehyde odour will have disappeared, while objects in the room remain uninjured with respect to their structure and colour.

OUR SCOTCH LETTER.

Inspectorial Changes. It has been officially announced that on the 16th of September Dr. John Kerr, H.M. Chief Inspector of Schools and Inspector of Training Colleges, will retire on a pension, after thirty-six years' service. His place at Edinburgh will be taken by Dr. Ogilvie, now Chief Inspector at Glasgow, who will be succeeded by Dr. Stewart, now Chief Inspector at Aberdeen. The vacant Chief Inspectorship has been conferred upon Mr. Alexander Walker, H.M. Inspector at Perth, who will be transferred to Aberdeen, in succession to Dr. Stewart. Mr. Francis R. Jamieson, M.A., of Edinburgh University, has been appointed an Inspector of Schools to fill the vacancy caused by the foregoing changes. Further transfers will probably follow, but they are at present unknown.

Teaching Politics. A teacher across the Border seems to have got into hot water in a very simple way, and we refer to the matter for the purpose of pointing out how readily the most innocent action may be misconstrued. It is expected of children in the highest classes, in England as in Scotland, that they should be able to read intelligently from any magazine or newspaper which the Inspector may bring with him; and the teacher in question had very naturally and wisely practised her pupils in reading from newspapers. She had equally naturally chosen the leading articles as best suited to her purpose. One of these chanced to be a political article, hence this storm in a teapot. Verily, teachers require to walk warily.

Mr. Shaw's Scheme. Mr. Shaw, Solicitor-General for Scotland in the last Government, has come forward with a scheme for freeing Secondary Education, and, it must be admitted, the scheme is a comprehensive one. Teachers would probably prefer that pensions should be provided with the first available money; but, if the next equivalent grant is not devoted to this purpose, many are of opinion that it could not be better spent than in completing our system of Free Education by extending it from elementary to secondary and technical, and, if possible, to University classes. Mr. Shaw's scheme embraces these three heads: (1) Free Secondary Education, with a free grant; (2) Distance Awards or Bursaries; and (3) Leaving Certificate Grants to carry pupils forward to the Universities. Mr. Shaw claims for his scheme that the best education would thus be brought within reach of every home in Scotland, and that without disturbing existing institutions. There is little chance of the scheme being carried out under the present Government; but, as Mr. Shaw will in all probability occupy a prominent position in the next Liberal Government, more may possibly be heard of his scheme.

The Registration Bill. The Registration Bill has gone for the present the way of many other innocents. The Educational Institute, through its sub-committee, carefully considered the Registration Bill of the Government, and its findings were approved by the General Committee. They are to the effect that registration is not a pressing professional necessity in Scotland; that the preponderance of representation on the Council should be in the hands of teachers, seeing that registration mainly affects them; and that the Government Certificate should qualify its holder for registration.

Dummy Codes. As is generally known, the Code for the year requires to lie upon the table of both Houses of Parliament for thirty days before becoming law. Considerable dissatisfaction is caused by the practice, becoming too common, of the Department laying what is called a Dummy Code upon the table. This, of course, prevents the possibility of discussing its terms, seeing that they are not known; and the practice is certainly not in accordance with the spirit of the requirement. The Institute has taken up the matter, and it is hoped the result will be that in future ample time will be given for the consideration of new proposals.

Notice of Code Changes Should be Given. Another matter that has for years exercised the minds of teachers is the fact that changes in the Code frequently come into force almost immediately on their being sanctioned by Parliament. It has been repeatedly pointed out to the Scotch Education Department that a full year should be allowed to elapse before the Code comes into force, and the demand seems so reasonable that it ought to be pressed till granted.

Class Subjects. We hear it occasionally stated that some Inspectors refuse to recommend the highest grants for Class subjects where only two are taken. We cannot find any justification for such an interpretation of the Code of 1895, and certainly none can be found in the Circular which was issued along with the Code. The following quotation from the Departmental report recently issued seems conclusive against any such interpretation: 'As the Code makes the highest grant attainable when only two subjects are taken, we hope that extent of requirement rather than variety of subjects will be aimed at.' Surely nothing could be clearer.

The Age Limit. The Galashiels School Board has been calling on other Boards to support a petition in favour of raising the age limit at which children are permitted to leave school. We regret to observe that this laudable desire has met with scant success, many Boards having sent no reply, while a majority of the replies received were against the proposal. The Glasgow and Edinburgh Boards are opposed to the raising of the age limit, and the Chairman of the Galashiels Board has boldly stated that their reason for this attitude lies in the fact that they would require to provide more school accommodation. If such be the case, the Chairman was quite justified in his remark that this is not a very enlightened view to take. If the country is to reap the full benefit from the enormous expenditure on education, the standard or the age for exemption must, sooner or later, be raised.

The Approaching Annual Meeting of the E.I.S. In addition to the usual routine business of the approaching Annual Meeting of the Institute, several important changes in procedure will fall to be considered, amongst others being the proposals of a Sub-Committee, appointed nearly a year ago, to consider the whole question of the business arrangements.

Presidential Address. There is so much business to be transacted at the Annual Meeting that it has been very generally felt for a number of years that some means will ere long require to be taken to curtail it. It has been suggested by some, in view of the fact that the President has the opportunity at the Christmas Congress of giving vent to his opinions on educational subjects, that the Presidential address at the September meeting might be dispensed with, while others are quite opposed to such an innovation. The Sub-Committee recommends a middle course—namely, that the retiring President's address should be delivered at a meeting of a social nature, to be held on the evening of the Friday preceding the day of the annual meeting. One advantage of this arrangement would certainly be that more time would thereby be given on the Saturday for the statutory business. There is this to be said against this plan, however, that on the Friday evening many of the delegates are attending meetings of the Currie Club, the Moray House Club, and other social gatherings.

Standing Orders. Another proposal of the Sub-Committee is that Standing Orders should be adopted for the regulating of discussion at all meetings of the Institute and its Committees. Any one who has been present at the last two annual meetings, and has witnessed the hopeless muddle into which the discussions have fallen, and from which the Presidents for the time being have had the utmost difficulty in extricating them, must have been struck with the necessity for some regulations on the subject. The report of the Sub-Committee has been approved by the Special and General Committees, and the general meeting would do well to give the proposed Standing Orders a trial.

Deer Overture. It will be remembered that at the last annual meeting an overture from the Deer Branch of the Institute was remitted to the General Committee for con-

sideration. The prayer of the overture was to the effect that an official should be appointed whose whole time should be devoted to the increase of the membership and the influence of the Institute. The Sub-Committee had this matter also before them; but, while strongly approving the principle of having such an official, they were of opinion that the funds of the Institute, though in a flourishing state, are not yet in a position to warrant such an appointment. It is recommended, however, that consideration should be given as to whether the duties of the new General Secretary might not with advantage be extended in the direction indicated by the overture.

The General Secretaryship. The appointment of General Secretary, which will be decided by the votes of the delegates present at the annual meeting, is causing considerable interest. Mr. Kerr is certainly the better known of the two candidates, having held the position of President. Mr. Laurence, however, has done a vast deal of valuable though unobtrusive work for the Institute during the past twenty years, not only as Secretary of his own branch, but by almost continuous service during all these years on every important committee. A point which it is necessary to keep in mind is that he has ample time at his disposal for the discharge of the duties of the post. This gives him some advantage over his rival, who, after a few months' experience of the secretaryship of the Glasgow Branch, found himself unable to carry on the work without the help of an assistant. The Institute will certainly not be disposed to appoint an assistant to the General Secretary, or to allow the duties to be performed by deputy. But perhaps the strongest argument advanced in favour of Mr. Laurence's candidature, from the point of view of public school teachers, is the fact that, if Mr. Kerr is appointed Secretary, not one of the permanent officials will be in touch with the wants of Code teachers, who form nine-tenths of the membership of the Institute.

Distribution of the Annual Report. The annual meeting in September last adopted, without discussion, the proposal of the Dundee Branch, that the annual report should be posted to every member direct, instead of being distributed through the local secretaries. The account for this item, which will swallow up a considerable slice of the surplus funds for the year, will probably alarm the annual meeting, and we should not be surprised to find the proposal made to revert to the former mode of distribution.

Scottish Education Vote. The statement of the Lord Advocate in the House of Commons shows that, though the past year has been an uneventful one, it has been a year of steady progress. Teachers will note with satisfaction that superannuation, though unavoidably postponed, is not being forgotten by the Government and Members of Parliament generally. The outstanding feature of the report for the year is the great progress of the evening schools, the numbers having increased almost fourfold in five years. There has also been an enormous increase in the number of candidates for the Leaving Certificate, the figures having risen from 972 candidates from 29 schools in 1888 to approximately 15,700 from 334 schools in 1896. Amongst other matters referred to in the discussion were fee-paying schools, free books, and school libraries, one speaker going so far as to urge that no school should be considered efficient in the sense of the Code which had not a school library.

NEW FOOD PREPARATION.—A food preparation recently introduced under the name of nutrose is made by mixing dried casein with the calculated proportion of sodic hydrate, boiling the mixture with alcohol of 94 per cent., and drying. In appearance it is a light, finely-divided powder, which dissolves in warm milk, water, or broth, without affecting their flavour, but when placed on the tongue has a slight cheesy taste. It is given in quantities of an ounce or two ounces daily, and is readily digestible. Dr. Stuve reports that it contains 13·8 per cent. of hydrogen. Eucasin is a preparation similar to nutrose. It consists either of an ammonia compound of casein, or of a compound of casein with hydrochloric acid.

NOTES AND NOTIONS.

BY T. B. ELLERY,

Ex-President of the National Union of Teachers.

Dr. McNaught. Every reader of this Journal will, I am confident, join me in congratulating Mr. W. G. McNaught upon the honour, thoroughly well-deserved as it is, recently conferred upon him by the Archbishop of Canterbury. The memorial to his Grace, asking him to confer the degree of Mus. Doc. Cantuar upon Mr. McNaught and Mr. G. D. Wood (Exeter), was signed by Sir John Stainer, Sir George Grove, and Sir Walter Parratt, so it will be seen the 'Sponsors' were of the highest standing in the musical world.

In the matter of this degree, 'honoris causâ,' Dr. McNaught is in good company, Sullivan, Mackenzie, Hubert Parry, and Villiers Stanford, amongst others, having had their work recognised in a similar manner. *Truth* says:—'For some reason, rightly or wrongly attributed to unworthy jealousy, several of our best musicians, such as Mr. Cowen, Mr. Manns, the late Sir Charles Hallé, and Sir Joseph Barnby, were never offered the degree at all.'

However that may be, we all rejoice that Archbishop Benson has been induced to recognise the excellent service which Dr. McNaught has for so many years rendered to the Education Department and the Training Colleges of the country, and we shall all join in wishing the new doctor many years of happiness and prosperity. My readers, of course, know that he has contributed to the columns of the 'PRACTICAL TEACHER,' and I imagine they have found those contributions extremely useful.

Personally, I trust he will again favour us with something from his pen when he has the necessary leisure.

Dr. McNaught! My hearty congratulations and best wishes for the future.

Reasonable Security of Tenure. In spite of the publicity which the N.U.T. officials give to cases of unjust dismissal, a publicity which should be sufficient to prevent such monstrous examples of intolerance and tyranny in future, we are, I regret to say, scarcely ever free from the consideration of some fresh case demanding immediate attention. On one occasion we were fighting for a teacher who was dismissed because he dared to have political convictions which were not in harmony with those of the Chairman of the School Board under which he served; at another time, it was a lady whose cause we were championing, and so on. Many cases we have taken to the County Court, the High Court, and every other Court open to us. We have not always succeeded, though our position has been sound, but one result of our agitation has been the creation of a public opinion which is now a very powerful force indeed in all these questions of capricious dismissal. Years ago we had to fight the battle alone; now we can always count upon the active support of a very large number of people in any place where we are compelled to take steps to expose tyranny and injustice. The teacher's work is now understood and appreciated, as the would-be tyrants often find to their cost. In some cases, I readily admit, Managers and School Boards act from what they conceive to be a sense of duty. The work does not appear to them to be as satisfactory as it might be; perhaps a change would be advisable! And, acting on this, the Managers request the teacher to resign. But these good people little know the difficulties under which teachers work, the anxieties, the hindrances, the disappointments, the slavery! In these cases, too, as my readers may well understand, there is work for the Union to do, difficult, delicate and anxious!

I am glad to be able to say that success frequently crowns our efforts, and the teacher is saved.

The Ponder's End Dismissal. Before these lines are in print the real reason for the dismissal of Miss Pottle, head mistress of St. Matthew's Church Schools, Ponder's End, Middlesex, may be 'known unto all men,' but up to the time of the meeting organised by the Union, no reason for

the dismissal had been made public, and indeed, at the time of writing I have heard of no reason other than the one given by Miss Pottle herself, viz., *that she had applied for a post under a School Board!* It may be, of course, that the Managers have a good and sufficient reason, but Miss Pottle has thrown down the challenge, and it has not been accepted. According to Prebendary Hodson, there is a charge of falsification of the registers, a very serious charge, I admit, and one which the Education Department has very properly been called upon to investigate. The first report of Mr. Sub-Inspector Kefford completely exonerated Miss Pottle, and suggested that some one else had made the alterations in order to injure the head teacher. A second report from the same gentleman, however, made some sort of modification, concluding as follows: 'Consequently my presumed charge against the assistant teachers cannot be justified, and I desire to cancel the paragraph in the special report which reflects upon them.'

Replying to Mr. Yoxall in the House of Commons, Sir John Gorst said the Inspector had been directed to forward the registers to the Education Department, where they would be carefully inspected, after which a further report would be sent to the Managers. Sir John also stated that the Committee of Council has no power to prevent the dismissal of the mistress! If wrongfully dismissed, therefore, Miss Pottle has no remedy and no sort of appeal, and I imagine it was Mr. Yoxall's object to draw this from the Minister of Education in order that the general public might clearly understand the teacher's position in matters of this kind.

DR. W. G. McNAUGHT.

The Meeting at Ponder's End. Having done all that was possible to bring about an amicable settlement and having failed, the Law Committee of the Union had no alternative but to hold a public meeting to protest against the dismissal. A large tent, capable of accommodating seven or eight hundred people, was erected in a field, and there the men and women of Ponder's End assembled to testify to their appreciation of Miss Pottle's services, and to show their sympathy with her in the position in which she found herself after twelve years' honest and successful work amongst them. Not only was the tent full to overflowing, but there was a great gathering of people outside, for whose convenience the sides of the tent were removed in order that everybody might hear all that was said. I was told that considerably over a thousand persons were present, and from actual observation I am inclined to believe that the estimate was a perfectly correct one.

Mr. Organ (the Law Clerk) made a very able speech, in the course of which he detailed the steps that had been taken to induce the Managers to reconsider their position. It was my duty on that occasion to give the history of the case as far as it was known to us, and I confess I was delighted to find the parents and inhabitants of the place generally so unanimous in their support of the lady in whose interests the meeting had been called. The first resolution was carried by a forest of hands *to four;* the remaining resolutions were carried unanimously! Mr. Blacker came up from Brighton to speak as a Church School teacher in defence of another Church School teacher, who, he considered, had been unjustly treated, and although it was late in the evening when he was called upon to speak, he rendered very effective service. A Mr. Pope intervened with a request that the good people assembled would wait until they heard 'the other side,' the very thing we all wanted to hear, the very thing we had asked for in several different ways, but had failed to obtain! Mr. Pope has followed this up with a letter to one of the local papers, in the course of which he charges me with having insinuated that the clergyman himself had tampered with the registers. I, of course, said nothing of the kind, and insinuated nothing of the kind, for I had no manner of evidence before me which would have justified me in so doing. If such evidence had been in my possession I should certainly have used it, whatever the consequences might have been. My statement was that the Union would do all in its power to discover the offender, and thus clear Miss Pottle, a position which I should have thought would have commended itself even to Mr. Pope! Why he should have taken upon himself to champion the cause of the Managers nobody knows, but even that may be made clear later on. I can only say that his reception by the audience was by no means encouraging, though we appealed over and over again for a hearing for him!

Miss Pottle's Professional Record. I was able to give the meeting some account of Miss Pottle's success, both as a student and as a teacher. She holds a First Division Certificate, several advanced Science Certificates, the full 'D' (Drawing), and other evidences of success in her examinations. For twelve years she has laboured at St. Matthew's School, Ponder's End, and during the whole of that time she has obtained 'Reports' which ought to satisfy the most exacting of Managers. As a matter of fact, the Managers have always been completely satisfied with her work, the three clergymen who have had charge of the parish during her residence there having, in letters to herself, borne testimony to her success in school and her personal worth. The present clergyman, the Rev. Martin Sharpe, has joined hands with his predecessors in this testimony, as recently as February of this year committing to paper his appreciation of her conscientious discharge of duty.

That being so, of course it follows that Miss Pottle's 'offence' must have occurred between February and June, and equally of course there should be no difficulty in making the matter public, especially as Miss Pottle has demanded that the reasons for her dismissal should be given to the world. As I said at the outset, my readers may be in possession of further particulars before these lines are before them; but I should be failing in my duty if I did not at once give the facts as they have reached me, together with the results of my own personal investigation. Let the Managers state how many times one of their number has checked the registers and certified in the log book that *they have been correctly marked.* We can supply the information, if there is any difficulty or scruple in the matter.

Suggested Arbitration. Major Bowles, M.P., has done good service in suggesting arbitration, one arbitrator to be appointed by the National Union of Teachers, one by the National Society, and one by himself, the points to be submitted being:—

1. Was Miss Pottle capriciously dismissed?
2. Are the reasons for her dismissal proved by the evidence given to the arbitrators?
3. Are those reasons sufficient to justify her dismissal, having due regard to the good management of the school?

The Managers, in reply to this, have asked to be allowed to postpone their acceptance of his proposal till they have heard from the Education Department.

Major Bowles, in a letter to the local papers dealing with this suggested arbitration, declares: 'I am quite of opinion that steps should be taken by the Government to make some

arrangement in the next Code, by which written contracts must be made with the teachers in the future.'

Mr. Jacques of Deane: Another Dismissal. The trustees of Deane School 'do not consider that it is desirable, as a general rule, for the schoolmaster of a Church School to be a churchwarden of the parish, except with the full assent and approval of the vicar and School Managers.' These gentlemen are, however, good enough to say that 'this is merely their opinion, and that they never sought to force that opinion upon Mr. Jacques in any way.' From the published statement of the trustees, it appears that 'two or three years ago, in consequence of something stated by the vicar in a sermon preached in Deane Church, Mr. Jacques had followed the vicar into the vestry and there openly called him a liar in the presence of the choir. . . . As Mr. Jacques did not volunteer any explanation of his conduct, or express the slightest regret for what had occurred, but, on the contrary, by his manner appeared to consider that what had passed needed no apology, the trustees gave him three months' notice to terminate his engagement.'

If the report of the vicar's sermon be a correct one, the rev. gentleman stated that the Bible had not been opened in Deane School for nine months in the year, that the schoolmaster was paid to take part against him, and that the very children were taught to despise and dishonour him. These are very grave charges, and one would have thought that the pulpit was the very last place from which to make them.

If they *were* made, who can blame the teacher, conscious that there was no foundation for them, for defending himself at the earliest possible moment? His manner of doing so might have been open to some objection, but allowance should surely be made for a man attacked in such a way and in such a place. Moreover, before the trustees met to consider the question *some two or three years had passed by*.

Mr. Jacques has offered to apologise under certain conditions, and he has offered to take other steps which should completely satisfy the trustees; but it appears that nothing less than absolute humiliation on his part will be accepted. That being so, the case is still open. Of Mr. Jacques's popularity in the place there can be no question. He has the people at his back, and that must be some consolation to him at a time when he needs all the support and sympathy which can be given to him.

Expert Testimony to the Value of the Tonic-Sol-fa System. I might go on for some time giving interesting quotations from the congratulatory letters to Mr. Curwen which lie before me as I write, but I cannot afford the space. However, a few words from the 'musical world' ought to be included with those I have already given. Cav. Alberto Randegger sends 'sympathy and very best wishes for continued and ever-increasing success.' Mrs. Mary Davies is of opinion that 'when the history of the 19th century comes to be written, the movement of which your father was the founder, and of which you are at present the acknowledged head, will stand out as one of the most remarkable and educational forces of the time, for it has brought the refining influence of music to the homes of the people.' Mr. Durward Lely knows 'something of the extent to which the musical training of the great masses of the people is in your hands.' Dr. E. J. Hopkins could not 'let the occasion pass without sending an expression of heartiest goodwill and hope for continued success.' Mr. Ben Davies asserts: 'The system of the Movable Doh is, in my humble opinion, the only true way for singers; it makes them feel the key at once, which I take to be the one great reason that Sol-faists so invariably sing in tune.' And then how delighted Mr. Curwen must have been to receive such a charming letter as that penned by dear, ever-popular Antoinette Sterling! Here is an extract: 'Kindest greetings, and honour and blessings be upon you and yours as the benefactor of millions of dear little children, as well as big ones. The best singers and artists that I meet are Tonic Sol-faists. Jean, my own little daughter, is a pupil of Mr. McNaught—blessings on him, too. Power and glory are yours and his now and for ever. . . . Jean transposes Chopin into any key from her knowledge of Tonic Sol-fa.'—My hearty congratulations to you, Mr. Curwen, and best wishes for continued success.

EDUCATION ABROAD.

THE 51st Congress of Dutch teachers took place at Leeuwarden on July 28th to 30th. According to the *Journal des Instituteurs* fully 98 per cent. of the local teachers' organisations were represented, and there were also delegates from Belgium, England, and the Dutch Indies. M. Kappenburg, of Amsterdam, the president of the Federation, took the chair. Among the questions discussed were the following:—How can the school, with the assistance of the police, combat the misconduct of children in the streets? The congress passed resolutions declaring that the teacher, and not the police constable, was the proper person to deal with this evil, and that any case of such misconduct should be promptly reported to him. The congress also voted 100 florins to the library of the Federation at Amsterdam, 5,000 florins to the Assistance Fund for teachers in distress, and 200 florins to the commission charged with the organisation of a movement for a Widows' and Orphans' Fund to be created by the Government. The congress for 1897 will meet at Zaandam.

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THE Hungarian Educational Congress held on the occasion of the National Exhibition at Buda-Pesth threw the movement for a Magyarisation of the schools into strong relief. The Magyars are not a little proud of their nationality and their country, and since their liberation in 1848 have worked hard to bring themselves up-to-date in every respect. When, however, the Magyar language is made to replace German in all public announcements and documents, and when the Germans, Poles, and Roumanians in Hungary are made to feel the vitality of the national idea from the Magyar point of view, things grow somewhat uncomfortable. The keynote of the Congress was the unification and national organisation of the elementary schools. Mr. Berzeviczy, one of the Secretaries of State, demanded a stricter State control of all schools, even those not State-aided, and that teachers' diplomas should be granted by the State only. The enforcement of these principles may lead to conflict in Siebenbürgen and elsewhere.

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THE infliction of corporal punishment by teachers in Prussia is now regulated by the following official pronouncement:—'The teacher is fully authorised to administer "painful corporal chastisement" both to pupils of his own and of other classes. Since the behaviour of pupils is subject to the school discipline outside the school as well as inside, the teacher may also apply such punishment outside the precincts of the school. The same right belongs to the clergyman in his capacity of religious instructor. Cases of school discipline are only subject to legal proceedings when a perceptible and essential injury has been inflicted upon the pupil. But a perceptible and essential injury is only that which can be proved to endanger the life or health of the pupil. Blood suffusions, black spots and stripes do not belong to such injuries, for every painful chastisement leaves those marks.'

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THE *Deutsche Blätter* quote the following significant case illustrating the great need for a revision of teachers' salaries in Prussia:—In the village of Sakuten (Eastern Prussia), the teacher is 26 years of age, and six years in office. In Schwarzort the postman is 19 years old, and six months in office. The teacher had to spend six years and £75 on his training, while the postman had worked as a labourer and had made some money. Both are now equally paid at the rate of 45 marks per month. Similar cases occur by the hundred, a very large number of teachers being salaried at from £27 to £32 per annum.'

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THE number of girls and boys under 16 years of age engaged in textile industries in Prussia has increased from 22,000 in 1894 to 25,000 in 1895. There has been a similar increase in the paper manufacture and printing works, but the number engaged in the mining industries has fallen from 17,000 to 7,000. This is supposed to be due not so much to the stricter regulations governing this industry as to a desire to avoid keeping elaborate attendance books for the information of the inspectors.

THE Catholic Clergy of the Palatinate have organised a remonstrance, to be signed by all Government inspectors for submission to the Bavarian Government, against the activity of the Teachers' Association, which, they say, works for the establishment of undenominational schools and the total abolition of clerical control. The Government is to be asked to put a stop to the 'anti-religious activity' of the teachers. It will be interesting to see which side the Government will take.

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'How to obtain none but well-fed teachers at the lowest salaries' is a problem which has been solved by a Bohemian district councillor in a simple and ingenious manner as follows:—'Dismiss all the under-fed!' A teacher in his district received a letter stating that the councillor had heard that the teacher was too badly fed by his family. It was the talk of the village. As it was to be feared that the bad feeding would tell upon his health and efficiency, he was requested to put his house in order and ensure his proper feeding, and was warned that otherwise his dismissal would be the only alternative. As a matter of fact, the teacher has a large family, with which he lives in perfect harmony. With his miserable salary the rations per head are small; besides, he has only just recovered from illness. But the public cannot have underfed teachers, so they must go. Needless to say, the teachers are profoundly impressed by the wisdom of this principle and its discoverer, and are looking forward with joy to the happy results of its application.

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THE delicate and painful situations in which Belgian teachers may sometimes find themselves are illustrated by some cases quoted by the *Journal des Instituteurs*. At a school excursion, in which some Socialist town councillors took part, some of the teachers and pupils marched to a revolutionary song. The 'demonstration' was promptly suppressed by the school director, but he will probably get into trouble with the communal administration, which has a Socialist majority. In another town, a teacher was asked by the burgomaster to attend a *Te Deum* on the 21st of July, on the usual understanding, however, that nobody was obliged to attend it. The teacher informed his pupils both of the invitation and the reservation. The number of pupils who attended was very small, and the teacher incurred corresponding displeasure. In Limbourg, the 'invitation' took the shape of an order, and the majority of teachers had no choice but to obey. Such cases can only strengthen the movement for making the teachers Government officials, subject to the central authority alone.

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A THURSDAY school has, according to the *Petit Journal*, existed at Saint Etienne for some ten years, with an average attendance of 100 pupils, aged 6 to 13, mostly girls. The object has been to supplement the domestic education given in the national schools by practice in sewing, knitting, and mending. The school has the doubly-beneficial effect of making the children more useful and obliging at home, and of withdrawing them from the distractions of the street on the free week-day.

* * * * * *

IN an interesting article in the *Musical Herald*, Mr. J. Spencer Curwen describes his experiences of Norwegian school-singing as found in Christiania. The Norwegians, he says, are keen educationists, and have a fine body of folk-song to draw upon for the use of the children. In the Christiania schools, as in Germany, the children sing by ear from the time they enter (at the age of seven) until they are ten. After that they learn the same songs over again from the staff notation. The key of C, which does not suit the voices best, is unduly preferred. The Norwegians speak in very soft voices, much more soft than the Germans, and these soft voices often flatten. Mr. Curwen complains that the treatment of time is inadequate considering its difficulty, and the skill of the pupils as singers is far in advance of their knowledge of notation and power to read at sight.

* * * * * *

PUBLIC education in Burma seems to be making fairly satisfactory progress. During the year 1894–95, the number of schools increased from 14,823 to 15,084, or about two per cent., while the number of pupils increased three per cent. But this increase is exclusively in the private schools, those on the Public School list having decreased six per cent. One cause of this decline, says the *Indian Journal of Education*, is to be found in the unfavourable attitude of the Buddhist monks, who, while opposing secular education, do not hesitate to avail themselves more largely year after year of the benefits of the system of Results Grants. This hostility can be overcome, or, at any rate, toned down by Inspectors meeting them in their tours and convincing them of the harm they do to the cause of education by their opposition. Burma seems to be no exception to the generality of Indian provinces where 'the goal of every pupil's ambition' is a clerkship in some public office. Hence technical education is reported not to be thriving in the land. The Chief Commissioner is, however, doing his best by the opening of an Engineering School and of a Technical Class attached to the Railway Workshop at Insein. Nevertheless, much remains to be done in the way of Commercial and Art Instruction. The education of girls is spreading much more rapidly in Burma than that of the other sex. With regard to the total number of schools, Burma occupies the third place in the list of Indian provinces (Bengal and Madras being ahead), while in point of number of pupils under instruction, it takes the sixth place, being in advance only of the Central Provinces and Assam.

* * * * * *

A PANIC broke out among the girls of a New York school, when they were assembled in the playground, over a thousand in number. It was produced by one of the girls exclaiming in a loud voice:—'There he is, there he is now!' She ran indoors and upstairs, followed by the majority of her fellow-pupils, who gave piercing shrieks and cries for help. A large number of people collected about the building, and many of the girls were thrown down and trodden upon in their mad race to get into the streets. When Miss White, the principal, had restored some order, it was found that the rumour had been current that the devil would appear in the school some day, and the cry of 'There he is' had produced the wild panic. The rumour appeared to be based upon a threat of the coming of the devil used by one of the teachers to impress an unruly child.

QUERY COLUMN.

RULES.

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the *coupon* which appears on the back wrapper of the current number of the Journal.
3. Correspondents will oblige by stating, whenever possible, the source from which their query has been obtained.

The Editor of the PRACTICAL TEACHER reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

Lars Porsenna.—Divide 531 into 3 parts, such that when respectively divided by 6, 5, and 4, they shall be to each other, as 7 : 8 : 9. Prove your answer to be correct.

Royal Navy Assistant Clerks, Nov., 1895.

Supposing that instead of dividing by the varying quantities 6, 5, and 4, we divide each part by the same quantity 6.

If we allow the first quotient to be represented, as before, by 7, the second and third quotients will be represented by smaller quantities, since the divisor in their cases is larger than before.

The second quotient will be represented by $\frac{5}{6}$ of $8 = 6\frac{2}{3}$, and the third quotient by $\frac{4}{6}$ of $9 = 6$.

If we divide each part by the same quantity, the quotients will be as $7 : 6\frac{2}{3} : 6$, or as $21 : 20 : 18$.

$$21 + 20 + 18 = 59.$$

$$\therefore \text{ 1st part} = \frac{21}{59} \text{ of } 531 = 189.$$

$$\text{2nd part} = \frac{20}{59} \text{ of } 531 = 180.$$

$$3\text{rd part} = \frac{18}{59} \text{ of } 531 = 162.$$

$$\text{Proof } \frac{189}{6} = 31\tfrac{1}{2}.$$

$$\frac{180}{5} = 36.$$

$$\frac{162}{4} = 40\tfrac{1}{2}.$$

$31\frac{1}{2}$, 36, $40\frac{1}{2}$ are as 7 : 8 : 9, since $31\frac{1}{2} = 7 \times 4\frac{1}{2}$; $36 = 8 \times 4\frac{1}{2}$; $40\frac{1}{2} = 9 \times 4\frac{1}{2}$.

J. T. Luckett.—How many words can be formed from the letters of the word *Simoom*, so that vowels and consonants occur alternately in each word?—Hall & Knight's 'Elementary Algebra.'

Out of the letters given we can form three syllables, each consisting of a vowel and a consonant. These may be Si, mo, mo (A) or So, mi, mo (B), or if vowels come first,

Is, om, om (C), or Os, im, om (D).

Now let us permute these syllables in as many ways possible.

Out of (A) and (C) we can get each only $\lfloor 3 \over \lfloor 2$ or 3 permutations, since two syllables are alike in each. From (A) and (C) we get therefore 6 words in all.

Out of (B) and (D), since the syllables are all unlike, we get each $\lfloor 3$ permutations, or from the two together $\lfloor 3 \times 2$, or 12 permutations.

We can therefore form in all 6 + 12, or 18 separate words.

Red House.—

Solve $\dfrac{27 - \frac{3}{2}\sqrt{x} - x}{5\sqrt{x} + 8} = \dfrac{1}{50} + \dfrac{4}{5} \cdot \dfrac{7\frac{1}{2}\sqrt{x} - x^{\frac{3}{2}}}{4x - 7}$.

Cambridge Senate House.

Multiply all terms by 25.

$$\therefore \frac{675 - 37\frac{1}{2}\sqrt{x} - 25x}{5\sqrt{x} + 8} = \frac{1}{2} + \frac{296\sqrt{x} - 20x^{\frac{3}{2}}}{4x - 7}.$$

$$\therefore \frac{675 - 37\frac{1}{2}\sqrt{x} - 25x}{5\sqrt{x} + 8} - \frac{1}{2} = \frac{296\sqrt{x} - 20x^{\frac{3}{2}}}{4x - 7}.$$

Or—

$$\therefore \frac{671 - 40\sqrt{x} - 25x}{5\sqrt{} + 8} = \frac{296\sqrt{x} - 20x^{\frac{3}{2}}}{4x - 7}.$$

$$\therefore \frac{-5\sqrt{x}(5\sqrt{x} + 8) + 671}{5\sqrt{x} + 8} = \frac{-5\sqrt{x}(4x - 7) + 261\sqrt{x}}{4x - 7}$$

Divide numerators by denominators.

$$\therefore -5\sqrt{x} + \frac{671}{5\sqrt{x} + 8} = -5\sqrt{x} + \frac{261\sqrt{x}}{4x - 7},$$

$-5\sqrt{x}$ on each side cancels out.

$$\therefore 671(4x - 7) = 261\sqrt{x}(5\sqrt{x} + 8).$$

$$\therefore 2684x - 4697 = 1305x + 2088\sqrt{x}.$$

$$\therefore 1379x - 2088\sqrt{x} = 4697.$$

Complete the square.

$$\therefore -\frac{2088\sqrt{x}}{1379} + \left(\frac{1044}{1379}\right)^2 = \frac{4697}{1379} + \left(\frac{1044}{1379}\right)^2$$

$$= \frac{7567099}{(1379)^2}.$$

$$\therefore \sqrt{x} - \frac{1044}{1379} = \pm\frac{2750}{1379}.$$

$$\therefore \sqrt{x} = \frac{1044 \pm 2750}{1379}, \text{ and } x = \left(\frac{1044 \pm 2750}{1379}\right)^2.$$

Replies to Science Queries.

E. W. Page.—(1) Diagrams will appear in next issue. (2) Fully explained in Gregory's 'Advanced Physiography' (Nelson & Sons, 4s.). (3) Messrs. Longmans are the publishers.

C. E. Robinson.—The only apparatus needed would be some glass tube bent in siphon form and water. The mineral water siphons of the chemist shops would also be useful.

Science.—Solution will appear in next issue.

THE SCOTCH CERTIFICATE EXAMINATION SYLLABUS.

ONE or two notable changes appear in the syllabus just issued by the Scotch Education Department, in connection with the examination for teachers' certificates. To begin with, there is a reversion to the 150 hours required to be spent in the practising school. It will be remembered that Their Lordships raised this number to 200, but since They did not make any corresponding reduction in the other parts of the syllabus it was felt that this new demand could not be met without detriment to other parts of the college work. That this is the view of Their Lordships is borne out by the fact that in the present syllabus there is an evident determination to reduce the amount of mere routine examination work as far as possible. School management, for example, makes this year its last appearance on the first year's syllabus. 'In 1898, school management will be omitted from the list of first year subjects.' This is not to be construed into an attempt to minimise the importance of this subject. It is one that must be taught whether it is examined upon or not. It is a poor training college that requires the whip of an examination to drive it to teach the essentials of a teacher's work. The question, indeed, of abolishing the first year's examination altogether is already within the region of practical politics, and may ere long be an accomplished fact. The Inspectorate are strongly in favour of this move, and if some of the training college authorities are a little afraid of the effect on their students, this is only an argument the more in favour of the change. It is a somewhat pitiful confession on the part of a college, that it cannot ensure that its students do their work unless its staff is supported by the external examiner.

Geography and history are at last doomed. In 1898, those terrible scourges will disappear for ever from the syllabus in the case of *all* students; and of all acting teachers who have at the scholarship or a previous certificate examination passed in those subjects. Always a plague, those memory-tormentors cannot pass from the syllabus without a farewell kick. We are told that 'candidates who passed with credit in this subject at the Queen's Scholarship Examinations, in December 1895, may omit it at this examination, and may take an extra language or science instead.' Candidates, therefore, who have passed geography and history at the entrance examination will, in July 1897, be permitted to take up two languages, and *four* sciences. For this is the only meaning that can be drawn from the words in section 5, under the heading *Science*—'Candidates will be allowed marks at the Certificate Examination in 1897, for a pass in the elementary stage or for a first or second class in the advanced stage (or in honours) for only *two* of the above subjects (in addition to the elementary stage of Science Subject I.), *unless they are taken in substitution for Geography or History*.' To be sure, under *General Regulations*, we read that 'candidates may not take up more than *four* subjects under the heads of Languages and Science, exclusive of practical plane and solid geometry.' But the exception above quoted obviously over-rides the general rule. None but a very exceptionally gifted candidate will dream of attempting four sciences in addition to two languages. In the training colleges the attempt would not be allowed, and in the case of acting teachers it will be well to take Geography and History over again, *even though those subjects have been already passed*, in order to secure the marks accruing from them. The present regulations regarding the marks for geography and history are eminently unsatisfactory, but this year will see the last of them.

In connection with the science subjects, it is to be regretted that Science Subject I. still retains its place among the compulsory requirements for the Full Drawing Certificate, in the case of women. It is universally admitted among teachers, training college authorities, and even Science and Art Inspectors themselves, that the strain of this subject in the case of women is excessive. No doubt it is a most valuable educational organon, but in the case of female students its cost is too great. We trust it will not survive the present syllabus.

The science examinations of students in training are evidently to be held at a somewhat later date than the ordinary May examinations, and are to differ slightly from them:—'Questions are also set on the method of teaching various branches of the subject, and the answering of one or more of these questions may be made compulsory.' This is as it should be. The only other change in the science arrangemente is the rule that 'every student who takes a science subject in his first year must take *i'hysiography*, unless he has passed in that subject at the examination previous to his obtaining his Queen's Scholarship. If he fails to pass the elementary stage in his first year, he must take it up in his second year. If he passes in his first year, he may select another subject of physical science, or mechanics in his second year, and may take either the elementary or the advanced stage of the subject chosen.' This rule does not apply till 1898.

In July a circular letter was issued to the training colleges, stating that in the syllabus about to be issued there would be a regulation permitting students to profess both notations in music, with a corresponding increase in the number of marks available. But it is in vain that we search the syllabus for the fulfilment of this promise. We are met by the emphatic words, 'candidates may answer questions in one notation only—*not in both*.' The italics are not ours. The change must come soon, the colleges are ripe for it, and the examiners are eager to carry it out. Its postponement is one of the mysteries that maintain the dignity of a Government Department.

In the branches special to female students, we find the fateful words, 'In 1898, Domestic Economy will be omitted from the list of second year subjects.' This, again, is as it should be. Domestic Economy has always been regarded as a subject that every girl knows well enough not to study any more. No doubt this is a mistaken notion, but it had its effect in rendering the subject peculiarly distasteful to students, particularly during the second year. In Needlework there has been no change, though some change was more than half expected. Since the Directress of Needlework, however, has to some extent modified her demands in the matter of preparation for her annual visit to the training colleges, there is not the same crying need for reform that up till now has existed.

Viewing the syllabus as a whole, it must be regarded as an honest and successful effort to improve upon the present state of affairs. All the changes are in the right direction, and give confidence to candidates and teachers in looking forward to the syllabus of 1898.

REPORT ON SECONDARY EDUCATION IN SCOTLAND.

It has seldom been our lot to read so wise, so useful, and so interesting a report as Mr. Craik has here presented to us. He takes a wide view of the whole field of secondary education in Scotland, and speaks with full sympathy as well as knowledge. Generally speaking, things are going well, though the secondary schools are still suffering under disadvantages from which the State-aided schools are free. The secondary school buildings are not what they ought to be, and the parents of secondary school pupils are no better. It is refreshing to find the official censure falling at last on the right shoulders: 'If it (the day school system) is to have a fair chance, it can only be by each parent feeling that he has a duty to his son and to the school, and that nothing but gross selfishness and carelessness can permit him to set that duty aside for the sake of personal convenience.' There is more to the same effect, fixing the blame mainly on 'the wealthier quarters.'

The secondary schools still complain that the elementary schools send in badly prepared pupils, who are a drag on the others. The secretary suggests that the secondary schools should institute a special class for drilling up those backward pupils.

The total number of candidates for the leaving certificate this year is 15,735, being an increase of over 2,500 compared with last year. Of the whole, 10,647 candidates came from the secondary departments of State-aided schools. The results of the examination of those State-aided candidates (among whom are included the pupil teachers) are compared with those of the secondary school candidates, naturally very much to the credit of the latter. The pupil teachers get a special note: 'It is not without interest to find, as might indeed be expected, that while the pupil teachers in State-aided schools make a good appearance in writing, spelling, and methodical work, their range of knowledge is less than that of the higher school pupils, while in originality and literary sense they are altogether inferior to these.'

A note that every good teacher will lay to heart is: 'The experience of all those taking part in the examination, repeated year after year, is of great weight, and its uniform tendency is to prove that the efficiency of a school is the determining matter, and that the variety of individual capacity is comparatively small. This remark, of course, chiefly applies to the ordinary certificates of the higher and lower grades, and in a much less degree to the Honours certificates, which imply individual excellence.' Throughout the whole system of examination there is a very obvious desire to avoid anything which will interfere with the free development of the individual characteristics of each school. In the report on English, for example, exception is taken to the current style of mechanical parsing and analysis, which is not founded 'upon any very solid or logical basis.' Yet the report goes on to say: 'It is difficult, however, to ignore those subjects so long as they form, as they evidently do, an important part of the curriculum of the schools.' The teachers are here assumed to have a free hand, which is hardly the case. Let the examiner for a couple of years 'ignore' those subjects, and the curriculum will be rid of parsing and analysis. In the face of a report like this, however, it is a pity that teachers should not take joint action and modify their curriculum according to their own sense of what is right. Teachers should seize every opportunity to exercise their right to determine what they shall teach.

Mr. Craik is disappointed at the baldness of the prose submitted by candidates, and by their inability to understand 'poetical and even literary expression.' He considers that this unfamiliarity with literary English 'is due to the use in school books and by teachers of a language so strained in its simplicity as to be childish. To speak or write over a pupil's head is doubtless an error, but it is not so serious or so hurtful an error as to speak down to him, and to assume an affectation of simplicity which relaxes his energies, and gives him a false and misleading model.' School books certainly do err in this direction; but this is the first charge we have come across of over simplicity in the language of a Scottish schoolmaster. Shade of Dominie Sampson, what are things coming to! The unexpectedness of the charge is no argument against its truth. It will be well for our readers to examine themselves and their friends in this particular. Mr. Craik is only an onlooker; he may see most of the game.

The remarkable feature of the report on the languages is that (except in French) most of the papers show a relatively higher power of translating into the foreign language than from it. This the report justly deplores, not only for the sake of candidates who will afterwards be at a disadvantage in the Civil Service and other examinations, but also for the loss it implies of much of the 'stimulating and liberalising effect' of the literatures in question. The cause of this peculiarity is probably twofold. First, the natural schoolmaster tendency to overestimate mere grammatical knowledge; secondly, the fact that this is the only part of the paper of which a candidate can be sure at this examination. It is well that the report takes such a sensible view of the matter. The great defect of our British style is that, as compared with continental nations, we read so little of the languages we study, particularly the classics.

The long and careful report on mathematics contains nothing specially new. There is the usual complaint that candidates will not take the trouble to read the questions. Even in secondary schools candidates are found who 'failed to take into account the reasonableness of their answers. Thus, one candidate estimated the cost of papering a room at over four million pounds.' It is pleasant to read the remark: 'A few words of praise may be added for some of the remote

schools where careful teaching of a few pupils produced good results.'

There is a trace of the usual heartburnings due to comparisons, in the conclusion of the report. Their Lordships have always 'avoided any comparison between the results of the leaving certificate examination in particular schools, and have expressed regret that such comparisons should be instituted.' But since such comparisons are being made every year, it seems fair to Their Lordships to prohibit the use of the lower arithmetic certificate in computing the number of certificates gained, since it is not at all of the same value as the other certificates. To serve the same end it would be well that Their Lordships stopped the practice of presenting the same pupil several times in the same stage of the same subject for the purpose of swelling the number of certificates annually gained.

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Head Master of the Belvedere Pupil Teachers' Centre, First on Scholarship List, Author of 'Scholarship School Management.'

PUPIL TEACHERS' COURSE.

1. For April 1897.—Fifth Month.

Work to be Prepared.

A.—*English.*

(N.B.—As limited space prevents treating the special English books as fully as may be necessary, students must write for assistance if they experience any difficulty.)

First Year.

1. The Adjective. Learn a good classification, with definitions.

Note the Comparison and various methods of forming Comparative and Superlative Degrees, and the adjectives of irregular comparison.

2. Learn one-half of the Latin noun suffixes.

3. Prepare verses 17–20 of Gray's 'Elegy in a Country Churchyard.' Learn the meanings of all allusions, references, and derivations.

Second Year.

1. The Verb: Voice, Mood, Tense, Number, and Person.

Note Transitive verbs only have voice. There are three finite moods: Indicative, Subjunctive (which carefully note) and Imperative, and one Infinitive Mood.

Three Tenses—Present, Past, and Future, Perfect and Imperfect.

2. The Anglo-Saxon Noun Prefixes, with examples.

3. Prepare lines 150–193 of the 'Winter Evening' (*Task*, Book IV.). Make sure of meanings, learn all notes, explanations of allusions, derivation of chief words. Be particularly careful with the paraphrasing.

Third Year.

1. Finish the Latin Suffixes with meanings and examples.

2. *Julius Cæsar.*—Prepare thoroughly from the assassination to the end of Act III., Scene 1. Note carefully the speeches of Brutus and Antony. Study the meaning carefully, be prepared to paraphrase and analyse any part (write for assistance in difficulties) and parse any word.

B.—*Arithmetic.*

First Year.

Boys.—Lock. Work Example LV. Nos. 21–50, and Example LVI.

Girls.—Dixon and Beach. Read Chapter X. and work Examples. The theory of this Chapter is of the greatest importance, and is more frequently questioned on than any other part.

Second Year.

Boys.—Lock. Work the whole Example CXIV. (a very common type of sum.)

Girls.—Dixon and Beach. Read Chapters XVI. and XVII. and work the Exercises (Addition, Subtraction, and Multiplication of Decimals).

Third Year.

Boys.—Lock. Work Examples for Exercise Nos. 901–925.

Girls.—Dixon and Beach. Chapter XXV. and Examples.

C.—*Music.*

First Year.—Two, three, and four pulse measures.

Second Year.—Thirds of a pulse.

Third Year.—One-fourth of the musical terms in common use.

D.—*Spelling.*

Learn 50 words per week from 'Words Commonly Misspelt.' or any good list, and test by Dictation.

E.—*Geography.*

North America.—Physical Features, Climate, and Productions.

This work involves the retention of a great number of new names. The only way to fix them in the memory is to draw a map, insert all places to be remembered, and go over them continually till they and their positions are thoroughly known.

F.—*History.*

George III. 1760–1793.

Chief points:—

(*a*) The close of the Seven Years' War, and the Treaty of Paris, which not only secured our supremacy in India, but also made over to us the whole of Canada.

(*b*) The affairs of John Wilkes. Note that his popularity was not due to his personal character, but because he was fighting for freedom of the press.

(*c*) The war with the American Colonies. This must be most carefully studied, as it is of great importance.

(*d*) The Treaty of Versailles.

(*e*) The Gordon Riots.

(*f*) Pitt's Administration, and the progress of the French Revolution up to 1793.

G.—*Euclid.*

Second Year.—Book I. Propositions 11–15, and four deductions per week.

Third Year.—Book I. Propositions 39–42, and four deductions per week.

H.—*Algebra.*

Third Year.—Read carefully Chaps. X. and XI., and work the Exercises given. These factors are of the greatest importance, and must be thoroughly mastered.

I.—*Teaching.*

Second Year.—'Scholarship School Management,' Chapter IV. The Teaching of Reading.

Third Year.—'Scholarship School Management,' Chapter X. pp. 88–98.

Questions to be Answered.

1. *Penmanship.*—Write as specimens of:—

(*a*) Largehand: Jurisprudence, Kleptomania, Lycurgus, Metonomy.

(*c*) Smallhand: There is not in the wide world a valley so sweet. (A subject requiring very great and continual attention.)

2. Write an essay each week, selecting from—Friendship, Decision of Character, The Fox and the Grapes, Humility, Kind Words, Empty barrels make the most sound.

(A very useful little book on this subject is 'Essay Writing,' by T. E. Jacob (Macmillan & Co.).

3. Notes of Lessons. (A criticism lesson to be given each week.)

Fishes, Multiplication of Money, Rain and its uses, A Sparrow, Classes of Birds, The Diving Bell, Gunpowder Plot, Rice.

4. *First Year.*

1. Analyse verse 13 and parse *rich*, *did unroll*, *their*, *rage*, *penury*.

(2) Analyse verse 15 and parse line 57, *may rest*, *guiltless*.

(3) Analyse verses 16 and 17 and parse *to command*, *ruin*, *plenty*, *alone*, *crimes confined*.

(4) Analyse verse 19 and parse lines 73 and 74.

(5) Give the meaning of the suffixes in the following words: *knowledge, penury, genial, purest, sweetness, inglorious, mankind.*

(6) Explain the meaning of fretted vault, rod of empire, chill penury, some village Hampden, the madding crowd, the Muse's flame.

Second Year.

(1) Paraphrase lines 120–129; 139–149; 158–166; 174–188.

(2) Analyse lines 128–135; 151–157; 167–176; 189–193.

(3) Parse: *like ashes* (121), *white* (123), *than* (124), *all unlovely as* (128), *thee king* (139), *of sounding an alarm* (146), *a wreath* (156), *when all besides* (157), *made vocal* (159), *volume closed* (167), *such as* (169), *delicious* (170), *spare feast* (173), *religion, frenzy* (178), *evenings* (189), *evenings* (190), *as more* (192), *mine* (193).

(4) Give the derivation (prefixes and roots) of the following words: *inverted, congealed, impatient, compensating, instructive, dispersed, retirement, symphonious, proscribes, exciting, omnipotent, illumined.*

Third Year.

(1) Paraphrase (*a*) Act III. Scene 1.

Cæsar. I must prevent thee, Cimber.
. . . . . will he be satisfied.

(*b*) Act III. Scene 1.

Cæsar. I could well be moved . . . .
. . . . . to keep him so.

(*c*) Act III. Scene 1.

Antony. I know not, gentlemen, . . .
. . . master spirits of this age.

(*d*) Act III. Scene 1.

Antony. O pardon me . . . .
. . . . parts of Italy.

(2) Analyse the same passages.

(3) Parse—(*a*)

So oft as that shall be,
So often shall the knot of us be called
The men that gave their country liberty.

(*b*) Your voice shall be as strong as any man's
In the disposing of new dignities.

5. Say what you can of the Transvaal and its people.

6. Make a list of the British Possessions in Africa (excluding Cape Colony and Natal), and give an account of one of them.

7. What was the South Sea Bubble? Explain clearly the cause of the distress.

8. How was the foundation of our Empire in India laid?

OCTOBER EXAMINATION, 1896.

SEPTEMBER—12TH MONTH.

WORK TO BE PREPARED.

A.—*English.*

First Year.

1. Revise all suffixes and notes in Grammar.

2. Prepare the second half of the 'Ode on Eton College.' Be prepared to analyse any part and parse any word. Learn all meanings, allusions, and the derivations of the chief words.

Notes.—

Verse 6.—'Of ills to come.' Enlarg. of sense.
'Train.' Nominative to 'wait.'
'To seize their prey.' Infinitive Phrase of purpose—Extension of stand.
'Them.' Indirect Object.
'They are men.' Direct Object. Noun Sentence.

,, 7.—'Vultures,' 'anger,' 'fear,' shame.' In apposition with 'passions.'
'Jealousy,' 'envy,' 'cure,' 'despair,' 'dart.' Nominative to 'shall waste.'

,, 8.—'From high.' Adverb of place.
'Sacrifice.' In apposition with 'wretch.'
'Eye,' 'remorse,' 'madness.' Nominative to 'shall try.'

,, 9.—'Family.' In apposition with 'troop.'
'Than.' Comparative Conjunction.
'Queen.' Nominative to 'is hideous' (understood).
'Poverty' and 'Age.' Subject of 'come' (understood).

Verse 10.—'Sufferings.' Nominative to 'will come' (understood).
'Tender,' 'unfeeling.' Nominative to 'will groan' (understood).
'No more,' read as 'I say no more.' 'More,' Objective case governed by 'say.'
'To be wise.' Gerundial Infinitive in apposition with 'it.'

Second Year.

1. Revise all prefixes. Make quite sure of classification and definition of all parts of speech and their inflexions.

2. 'The Traveller.' Prepare lines 360 to the end with all meanings, allusions, and derivations. Be prepared to paraphrase and analyse any part and parse any word.

Notes.—

Line 362.—'To flatter kings or court the great.' Direct Object of 'mean.'
,, 363.—'Aspire.' Infinitive Mood, attributive to 'soul.'
,, 370.—'To secure.' Infinitive of purpose.
,, 374.—'But.' Adverb of Degree, modifying 'to lay.'
'To lay . . . . each.' Completion of the Predicate 'is.'
,, 376.—Supply 'they are' = 'How blind they are.'
,, 380.—'Fast.' Adverb of manner, modifying 'approaching.'
,, 380.—'It freedom.' Double Object after the Verb 'call.'
,, 395.—The whole line is direct object of *have seen.*
,, 399.—'Destruction.' Objective Case governed by the Infinitive Verb 'to haste.'
,, 400.—'Like.' Adjective, qualifying 'triumphs,' and governing tapers in the Objective Case.
,, 402.—'Lead.' Infinitive, governing 'depopulation' in Objective Case.
,, 404.—'Repose.' Infinitive, attributive to 'opulence.'
,, 406.—'Fall.' Infinitive Mood governed by 'we have seen.'
,, 422.—'Sympathise.' Infinitive, governed by 'bids.'
,, 423. Supply 'has been.'

3. Paraphrase and analyse—

(*a*) Lines 367–376, and revise 'thou,' 'alike,' 'still,' 'clime,' 'only,' 'to secure,' 'must govern' 'each.'
(*b*) Lines 381–392, and parse lines 383 and 384.
(*c*) Lines 412–422, and parse lines 419–420.
(*d*) Lines 426–434, and parse 'though,' 'reign,' 'how small,' 'all,' 'still to ourselves,' 'own.'

(Individual difficulties will be solved through Correspondence Column or by post.)

Third Year.—Pope's 'Essay on Man.'

1. Prepare lines 259 to the end, with all meanings, allusions, derivations, etc.

Study the meaning carefully. Be prepared to paraphrase and analyse any part and parse any word.

General paraphrase:—

Lines 259–280.—What would be the result if the foot were to become dissatisfied with its work of supporting the body, and wished to be on equal terms with the head, or the head wished to be as powerful as the dominant mind? It is just as absurd for man to aspire to be equal to an order of beings which is altogether above him, or to pretend to criticise the dispensations of the eternal First Cause.

All things that we know go to build up one whole and perfect Universe, the visible and tangible part of which may be termed the body, while the soul—the directing and controlling influence—is God. God is omnipotent and omniscient, unchangeable and eternal. His presence and power is evinced in the warmth of the sun, in the refreshing influence of the breeze, in the glitter of distant stars, and in the blossoms on the trees; it appears in the life of all living things, in all time, and in all space; it operates everywhere, yet without division, and is continually used, though it never de-

creases. There is no limit as to its sphere of work; it is as full and perfect in a single hair as in the whole body, in complaining and discontented man as in the perfect and adoring angel. The terms we use of time, space, and extent are unknown to God, who permeates, connects, and controls everything.

Lines ,, 281–294.—No longer, then, term 'imperfect' what is really the highest 'order'; be content to know and appreciate man's position and privileges, and be sure that, in this or in any other state, as much happiness is provided as can be borne, and that God watches over every individual from the day of his birth till his death. Everything is the highest degree of art, though not understood by man; what he terms 'chance' is direction, which he cannot understand; 'discord,' the highest perfection of harmony; 'partial evil,' the good of all. If we put away ambitious pride and imperfect reasoning, one truth stands boldly out: 'Whatever happens or exists must be right, for it is the decree of God.'

2. Revise all Grammatical notes, prefixes, affixes, etc.

3. The whole of the above should be paraphrased and analysed, and the parsing of each word noted. If any difficulty is experienced, write for assistance.

B.—*Arithmetic.*

All Years.

The whole of the last month should be devoted to finally reading up the theory and principle of the various years' work. Recent papers show that this is considered of great importance. The points most frequently asked about are the theory of G.C.M. and L.C.M., the theory of Fraction (explaining by diagrams the simple rules), Ratio and Proportion, the theory of Recurring Decimals, together with definitions of all terms used in Arithmetic. A test is given below which should be attempted under examination conditions as to time, etc.

C.—*Music.*

Revise any weak points and work test questions below.

D.—*Spelling.*

Learn 50 words per week from 'Words Commonly Misspelt,' or any good list, and test frequently by Dictation from a good writer.

E.—*Geography.*

Revision will occupy most of the time in this subject. Note-books, if properly kept, will prove most useful. It is of little use to attempt to anticipate the questions, but it should be borne in mind that *India* is specially noted in the Syllabus; the trouble in Crete and Armenia naturally directs attention to these places. Many answers in Geography are best answered in a tabulated form, and sketch maps to accompany answers are always valuable. The towns of Central Asia should be noted.

Practise the Memory Maps daily, allowing half an hour. Rule a neat border, shade coast with a little blue lead. Print clearly, horizontally, and not too small.

Prepare answers, if necessary, to questions below:—

Questions for Revision in Geography.

(*Selected from Department Examinations.*)

1. Describe the position of Belgrade, Cadiz, Copenhagen, Ancona, Rouen, Dresden, and Warsaw. Name some historical associations connected with three of them.

2. Describe two of the great mountain ranges of India, and name the rivers which rise in or break through them.

3. Say what you can of the productions of Ceylon.

4. Name some of the principal animals, trees, and fruits, which are not found in England, but are to be met with in India or Australia.

5. Name some of the famous buildings in Europe. State their locality, and why they are famous.

6. Describe a journey from London to St. Petersburg, *or* Madrid, *or* Constantinople, and say what interesting places or scenes worthy of a visit are in or near the towns you have selected.

7. Describe the position as accurately as you can, and say what you know of each of the following:—Bangalore, Cracow, Innsbruck, Rangoon, Trincomalee, Varna, Valetta.

8. Mention the principal rivers flowing into the North and Baltic Seas; say where they rise, and what important towns are situated on their banks.

9. Explain clearly how India is governed. Name the provinces and the chief towns of each.

10. Describe the positions of Rome, Agra, Seville, Belgrade, Lahore, Calicut, and Dresden.

11. What are the chief productions of Assam, Lombardy, and Holland.

12. Where are these places to be found?—Delhi, Kurrachee, Colombo, Cadiz, Adrianople, Heligoland, Munich, Florence, Simla, and Lucknow.

13. Name the chief races of men inhabiting Europe, and give their distribution and distinguishing characteristics.

14. Where are the following, and for what noted?—Dresden, Nijni Novgorod, Florence, Munich, Liège, Bergen, Hamburg, Bucharest, Brindisi, Palermo, Patna.

15. Describe the valley of the Ganges.

16. Show what political and what climatic influences any of the mountain ranges of Europe and Asia have had upon adjacent countries.

17. Where are the following, and for what noted?—Adrianople, Goa, Belgrade, Corfu, Cordova, Colombo, Sofia, Pondicherry, Cettinge.

18. Say what you know of the causes, effects, and times of the Monsoons in Northern and Southern Hindustan, respectively.

19. Name the chief European centres for wine, wheat, olives, oranges, silk weaving, horse breeding, tobacco, timber, tallow, and steel.

20. What are the chief industries of the south of France, the north of Russia, and of Sweden?

21. State what you know about the Dutch people and their language. Name the chief cities of Holland.

22. Contrast the life and surroundings of a Laplander with those of a Dutch peasant.

23. What is the area and population of India? Mention some of the different races found in it. From what parts of India do the Sikhs, Ghoorkas, and Mahrattas come?

24. Write four or five lines about *four* of the following—Laccadives, Landes, Sunderbunds, Isthmus of Corinth, Crimea, Darjeeling, and Finland.

25. From what parts of Europe or Asia do we obtain—attar of roses, sulphur, toys, copper, currants, pearls, furs, bulbs, tea and coffee?

26. Give a description of three of the following—Siberia, Afghanistan, the Red Sea, Corea.

27. Name the chief mountain systems of Asia, and give a description of one of them.

28. Where and what are Ava, Balkash, Tonquin, Singapore, Manilla, Krakatoa, and Formosa?

29. Name four of the chief rivers in Asia, their sources, the chief towns on their banks, and the sort of produce which is carried by means of them.

30. What Asiatic rivers flow into—(*a*) Sea of Aral, (*b*) Persian Gulf, (*c*) Arctic Ocean?

31. Give some account of the commercial and political position of Afghanistan and Japan.

32. Give a full account of the Persian Empire, the States by which it is bounded, the chief industries, the religion of its people.

33. Where are Ispahan, Smyrna, Agra, Merv, Tokio, Hong Kong, Herat, Yokohama, and Fusiyama?

34. Give some account of the river systems, climate, and products of Siberia, or of the Chinese Empire.

35. Say what you know of the Indo-Chinese Peninsula, especially of the Straits Settlements.

36. Describe a coasting voyage from Rangoon to Pekin.

37. Where and what are the following?—Hoang-ho, Amoy, Corea, Samarcand, Amur, Manipur, Everest, Persepolis, Dooab.

38. 'Asia throws out large offshoots on two of its sides; the gulfs which penetrate it are all the more valuable for commerce, inasmuch as great rivers flow into them.' Give as many instances as you can which will prove the above statements, and show that they prove them.

39. Give the exact position, and say what you know of the Tundra, Vladivostock, Goa, Kandy, Darjeeling, Aleppo, Yemen, Khelat.

40. What is known respecting the size and population of China? Give the names and position of its six largest towns, and say what you can of each.

41. Give some account of the government and social life of Japan. Name the countries in Asia which are—

(*a*) Under the rule of the Empress of India.
(*b*) ,, ,, ,, Czar of Russia.
(*c*) ,, ,, ,, Sultan of Turkey.

F.—*History.*

Revise all. Look over dates, the principal statutes and their provisions, wars, battles and treaties, plots, and biographies of leading men. The chief points have been sufficiently indicated in these problems. The questions below will give an idea of the usual scope.

Selected Questions in History.

1. Name, with dates, the chief events of the reign of Henry VI.
2. What do you know of Drake, Spenser, Cranmer, Somerset (Protector), and Raleigh?
3. Give, with dates, the chief events of the period 1340–1400.
4. What had England to do with Spain in the reigns of Edward III., Henry VII., and Mary?
5. Describe the relations between England and Scotland in the reigns of Henry VIII., Edward VI., and Elizabeth.
6. What connection do you trace between the Black Death, the Statute of Labourers, and Wat Tyler's Rebellion?
7. What claim did Henry VII. prefer to the throne? What difficulties did he have to contend against? With what purpose did he establish the Star Chamber?
8. What was the policy of Elizabeth with respect to religion? Who were the Puritans? Point out clearly in what way the presence of Mary Queen of Scots in England was a danger to the peace of the kingdom.
9. What claims did Edward III. and Henry V. put forward to the French crown, and how did their immediate successors maintain them?
10. Say briefly how armies, ships, and money were raised under the Plantagenets.
11. Sketch the gradual decline of the English power in France after the death of Henry V.
12. What do you know about the 'Good Parliament'? Show that its name was an appropriate one.
13. What led to Henry IV. coming to the throne? Was it a good thing for the country.
14. Mention the chief battles of the Wars of the Roses, and say what were the effects of these wars.
15. Who were the parents of James I.? Trace genealogically his title to the English throne.
16. Point out the strong and weak points in the character of Charles I., and illustrate your answer by events in his reign.
17. Give a short account of the chief ministers in the reigns of Henry VII., VIII., and Elizabeth (not including Cardinal Wolsey).
18. Show how the influence of the Court of France was exerted in the reigns of the later Stuarts, and with what result.
19. The Petition of Rights, the Grand Remonstrance, the Self-Denying Ordinance. Give the history of each of these.
20. Explain the terms:—Benevolences, Star Chamber, Ship Money, Exchequer, Legate, and Cardinal.
21. What do we hear of the Dutch in the time of Elizabeth, of Cromwell, and of Charles II.?
22. Compare the characters of Charles I. and Charles II., and account shortly for the troubles of the one reign and the comparatively peaceful character of the other.
23. Construct a table shewing the relationship either between Elizabeth and Mary Queen of Scots, or between James I. and William III.
24. How did Henry VIII. come to take part in Continental wars, and with what result?
25. Thomas Cromwell, Arabella Stuart, Anne Hyde, Regent Murray, Cardinal Pole, Marquis of Montrose. Say all you can about any four of these.
26. What industries do we owe to foreign immigrants, and what can you tell of the causes which made these foreigners leave their own country?
27. Who were some of the great sailors under the Tudor Sovereign? Describe the objects and results of their voyages.
28. What was the Navigation Act, and what results had it?
29. Where are Marston Moor, Edgehill, and Newbury, and what importance had the battles that bear these names?
30. How was the Dissolution of the Monasteries accomplished? Give particulars of any resistance that took place.
31. Give a short life of Shakespeare or Milton.
32. How might the greatness and weakness of Elizabeth be illustrated from events in her history?
33. Contrast the grievances of the nation under Charles I. and James II.
34. The Declaration of Indulgence, the Declaration of Rights, the Declaration of Breda. What do you know of these.
35. Henry VII. initiated the home and foreign policy of the Tudors. Can you explain this and illustrate it by examples?
36. What revolts took place in Edward VI.'s reign? What brought them about?
37. What led to the passing of the Poor Law Act of Elizabeth? State its main provisions.
38. Give an account of the foreign relations of England under Cromwell.
39. What were the chief events in Ireland in the reign of Charles I. and in the Commonwealth?
40. What were the chief causes that led to the dethronement of James the Second?
41. What was 'The Plantation of Ulster'? When was it effected, and how has it affected Ireland for good or ill?

G.—*Euclid.*

Finish revision. Work as many deductions as possible.

H.—*Algebra.*

The theory should receive attention, also definitions of all terms used.

Continue practice of any general examples.

I.—*Teaching.*

Revise by means of questions at the end of the book. Pay particular attention to Object Lessons and Word-building.

Questions to be Answered.

First Year.

Arithmetic.

Boys.—1. How are fractions compared? Show by a diagram that if the numerator and denominator of the fraction $\frac{3}{4}$ be multiplied by 2, its value is not altered. Compare $\frac{3}{4}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{5}{7}$; and find the difference between the sum of the greatest and least, and the sum of the other two.

2. If the smaller of the two fractions be $\frac{2}{3}$ and their difference $\frac{5}{21}$, what is their sum?

Find the quotient of the sum divided by twice the difference.

3. Simplify $\left(3\frac{1}{3} + \frac{2\frac{1}{2}}{6} - \frac{1\frac{1}{2}}{9}\right) - \frac{2}{5}$ of $\frac{1\frac{1}{15} - \frac{2}{5}}{\frac{1}{3}}$.

4. Find the value of 1·38 of £27, and express 6·875 lbs. as the decimal of $2\frac{1}{2}$ cwt.

5. If I gave away $\frac{2}{5}$ of my money and ·375 of the remainder, and have £1·6875 left, what sum had I at first?

6. Multiply £135 14s. $9\frac{3}{11}$d. by 96; and show whether $\frac{22}{7}$ or $\frac{333}{106}$ is nearer to 3·14159.

Girls.—1. What is meant by a 'factor' or 'measure' of two or more numbers?

Find the G.C.M. and L.C.M. of $13 \times 15 \times 17$, $15 \times 17 \times 19$, $17 \times 19 \times 13$.

2. Make out a bill for 7 packets of tea, each containing 5 oz., at $1\frac{1}{2}$d. per oz.; $8\frac{3}{4}$ lbs. of coffee at 1s. 4d. per lb.; 32 packets of sugar, each 3 oz., at $2\frac{3}{4}$d. per lb.; and $12\frac{1}{2}$ lbs. of fruit at $5\frac{1}{2}$d. per lb.

3. Find the cost of 825 articles at £2 17s. $8\frac{1}{2}$d. each.

4. What is the cost of 112 cwt. 3 qrs. 17 lbs. 8 oz. at £9 6s. 8d. per ton?

5. A merchant gave £27 6s. for 7 bales of cloth, each containing 24 yds. In each bale 2 yds. were wasted; at what price per yard must he sell the remainder in order to make a profit of £3 10s.?

6. Two pedlars buy equal stocks of toys which they sell at a penny each. One gave 5d. for 6 toys and the other got 7 toys for 6d., and made 3d. less profit than the other when the stocks were sold. How many toys were bought by each?

Answers.—*Boys.*—(1) $\frac{3}{4}$ greatest, $\frac{1}{8}$ least, $\frac{1}{16}$; (2)(*a*) $1\frac{11}{12}$; (*b*) $3\frac{1}{16}$; (3) $\frac{3}{28}$; (4) £37 10s.; ·02455 +; (5) £6 1s. 6d.; (6) (*a*) £13,030 18s. $2\frac{3}{11}$d.; (*b*) $\frac{333}{106}$.

Girls.—(1) G.C.M. = 17, L.C.M. = 62985; (2) £1 3s. $1\frac{1}{2}$d.; (3) £2,380 9s. $4\frac{1}{2}$d.; (4) £52 13s. $9\frac{1}{2}$d.; (5) 48s.; (6) 126 toys.

Music.

1. State between which tones of the following extended scale there are (*a*) major thirds, (*b*) perfect fourths.

d r m f s l t d' r' m'

2. Rewrite the following an octave higher in four-pulse measure, doubling the value of each note and rest :—

| d :.s$_1$ | m :-. | s.t$_1$:d. ‖

3. What are the mental effects of the following scale sounds when sung slowly ?—*soh, fah, te, lah, me.*

Second Year.

Arithmetic.

Boys.—1. Explain fully as to a class the meaning of the terms *principal, rate per cent.*, and *amount* as applied to Simple Interest.

What sum must be lent at Simple Interest at $2\frac{1}{2}$ per cent. per half-year to amount in four years to £2,360 ?

2. A house cost £750, and the ground rent is £20 a year. At how much a year must it be let to pay 5 per cent., after allowing 4 per cent. annually for repairs ?

3. 600 men were besieged in a garrison town with provisions for 35 days, allowing each man 18 oz. a day. How long would the provisions last if the garrison were reinforced by 300 men, and the daily allowance were reduced to 15 oz. a day ?

4. How much must a person invest in the $2\frac{3}{4}$ per cent. stock at $98\frac{7}{8}$ in order that he may have a yearly income of £233 after paying an income-tax of 7d. in the £ ?

5. A grocer mixes 16 lbs. of tea at 2s. 8d. per lb. with 28 lbs. at 2s. 6d. per lb., and 11 lbs. at 2s. 4d. per lb. What does he gain per cent. if he sells the mixture at 2s. 9d. per lb. ?

Girls.—1. From $11\frac{3}{8}\left(\frac{2\frac{1}{2}}{7}+\frac{4}{9}\text{ of }\frac{36}{40}\right)$

take $11\frac{3}{8}$ of $\frac{2\frac{1}{2}}{7}+\frac{4}{9}$ of $\frac{36}{40}$.

2. Reduce the sum of $\frac{3}{4}$ of 4s. $4\frac{1}{2}$d. + $\frac{7}{13}$ of 8s. $11\frac{1}{4}$d. to the fraction of $\frac{17}{19}$ of 7s. 11d.

3. Express the sum of $\frac{7}{10}$ of $\frac{5}{24}$ of a mile + $\frac{125}{960}$ of $1\frac{1}{5}$ of $\frac{1}{22}$ of a furlong as a fraction of 13 yards.

4. A train consists of an engine, tender, and 8 carriages. The weight of the engine and tender equal $\frac{5}{25}$ of the total weight of the train, and is 72 tons less than the weight of the carriages. Find the weight of a carriage.

Answers.—*Boys.*—(1) £1,966 13s. 4d. ; (2) £59 17s. 11d. ; (3) 28 days ; (4) £8,629 1s. $9\frac{9}{11}$d. ; (5) $98\frac{2}{3}$ per cent.

Girls.—(1) $4\frac{8}{10}$; (2) $\frac{3}{4}$; (3) $\frac{3}{8}$; (4) 17 tons.

Teaching.

1. Mention some manual occupations suitable for the lower standards, and say in what way they are useful.

2. Show how the four simple rules of arithmetic can be taught in their first stages by the combined use of the ball frame and the blackboard.

3. How can the blackboard be best used in the earlier stages of teaching writing ? Illustrate your answer by a word written in largehand.

Music.

1. Rewrite the following passage, making a change to the first sharp key at (*a*), and a return to the original key at (*b*) :—

Key C. (*a*) (*b*)

s m f t$_1$ d m fe s l fe d^1 t m f r d

2. Name the following intervals :—

r—ta, m—r^1, ta—s^1, d—t, t$_1$—f.

3. Write distinctly over each note and rest in the following its value in pulses or fractions of a pulse :—

| s :-.,l | m. :.f |

| t$_{1\,6}$-$_4$d :r | .m :d ‖

Third Year.

Arithmetic.

Boys.—1. Establish a general method or rule for reducing a circulating decimal to a vulgar fraction.

Simplify $\left(\frac{4\cdot\dot{6}}{7\frac{5}{8}}\times\frac{19\frac{7}{12}}{9\cdot\dot{3}}\right)-\left(\frac{3\cdot\dot{5}}{4\cdot\dot{1}\dot{6}}\div\frac{2\frac{11}{12}}{3\frac{1}{2}}\right)$.

2. An observer, on the platform of a railway station, noticed that a train passed him in 7 seconds, and that it passed completely through the station, which was 396 yds. long, in 25 seconds. How long was the train and how fast was it moving ?

3. Find to a fraction of a penny the true discount on £500 ; one moiety being due in 6 months and the other in 9 months ; discount being reckoned at 5 per cent. per annum.

4. A began business with £450 capital, and at the end of 4 months he took B into partnership with £300. Two months later they took C with £500 capital, but 3 months later C withdrew £250 from the concern. At the end of 12 months there was a profit of £502 10s. to be divided among them. Find each partner's share of that profit.

Girls.—1. After paying 7d. in the £ income tax, a person has £625 18s. $10\frac{3}{4}$d. What was his gross income ?

2. Find the value of ·8$\dot{3}$ of 13s. 4d. + ·13$\dot{8}$ of £1 4s., and express the result as a decimal of £13.

3. Equal quantities of tea, which cost 2s. and 1s. 8d. per lb. respectively, are mixed and sold for 2s. 2d. per lb. at a total profit of £3. How many pounds were sold ?

4. Large needles cost 1d. per score more than small needles. A girl who buys equal quantities of both finds that on the whole she gets 8 for a penny. What is the price per score of each kind ?

Answers.—*Boys.* (1) See good text-book ; ·266 ; (2) 154 yds. ; 45 miles ; (3) £15 2s. $8\frac{304}{3403}$d. ; (4) A = £270 ; B = £120 ; C = £112 10s.

Girls.—(1) £644 15s. ; (2) 14s. $5\frac{1}{3}$d. ; (3) 180 lbs. ; (4) 2d. and 3d.

Teaching.

1. How would you explain to older infants the notation of the number 10 ?

2. Mention five or six subjects suitable for Composition in Standard VI., and show how you would treat one of them.

3. Write notes of a lesson on one of the following subjects :—

(*a*) The Butterfly (Infants).
(*b*) Some of the applications of Steam.
(*c*) The Sky.

Music.

1. Name the following intervals :—*doh-re, re-doh*^{1}, *re-fah, soh-re.*

2. Which of the following is highest and which is lowest in pitch ?—*doh*^{1} in Key E♭, *soh*$_1$ in Key F, *ray*^{1} in Key D, *lah*$_1$ in Key C, *lah* in Key A.

3. Write out the following passage distinctly in four-pulse measure :—

$1\frac{1}{2}$ $\frac{1}{2}$ $\frac{3}{4}$ $\frac{1}{4}$ $\frac{1}{2}$ $\frac{1}{2}$ 1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{4}$ 2 $1\frac{1}{2}$ 1 $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{2}$

s m f r s REST d r m f m l s f m r d REST

SCHOLARSHIP COURSE.

9TH MONTH—SEPTEMBER 1896.

1. *Reading and Penmanship.*—Ten minutes' practice daily. The capital letters generally require much attention.

2. *Spelling.*—Fifty words weekly from 'Words Commonly Misspelt,' or any good list. Test by Dictation from standard authors.

3. *Composition.*—Write one or two Essays each week, selecting from—

(1) Letter-writing.
(2) Recent Arctic discoveries.
(3) Clouds.
(4) International arbitration.
(5) Poetry.
(6) Our Postal and Telegraph System.
(7) Autumn.
(8) 'A rolling stone gathers no moss.'

4. *English.*

(*a*) Learn 20 roots and meanings each week.
(*b*) Revise fully the grammar of the Noun.
(*c*) *Literature.*—Finish Chap. IX. Meiklejohn's 'Outline of English Literature.' Thackeray, Dickens, Ruskin, George Eliot.

Prepare lives and a tabulated summary of their works, style, etc.

5. *Arithmetic.*

Revise the theory of G.C.M., L.C.M., and Fractions, and work the test papers below.

6. *Algebra.*

Boys.—'Scholarship Algebra.' Chaps. XXX. and XXXI., and work examples.

Girls.—'Scholarship Algebra.' Chaps. XII. and XIII. Study carefully.

7. *Euclid.*—Revise Book I., Props. 30-48, and work four deductions each week.

8. *Geography.*—British possessions in America.
Note particularly Industries, Productions, Chief Towns, Government, etc.

9. *History.*—Charles I.
(This and next month will be devoted to the study of this reign, which is specially set for preparation. It will be necessary for all students to read the period more fully than from the ordinary text-book.)
Epochs of Modern History: The First Two Stuarts and the Revolution (1603-1660), *Longmans and Co.*, 2s. 6d., or *Green's History, Part III., Macmillans*, 3s., will be found specially serviceable.
Every endeavour must be made to trace all the causes which had been at steady work for centuries, and which helped to bring about the crisis of 1642. The gradual growth of the Commons from the time of De Montfort, the disappearance of the bold and independent Baronial party after the Wars of the Roses, the servility of the new (and in many instances corrupt) nobility, the Revival of Learning, the Reformation, the wonderful growth of the Puritans, and the personal character of the Stuarts themselves with their absurd theory of 'Divine Right,' all tended to the inevitable conclusion of a struggle for final supremacy between the people and the Crown.
For this month read up carefully the history of the early struggles, the Three Parliaments, the Petition of Right (properly considered the second Magna Charta), and the eleven years of absolute rule. Note the chief men of the period and their influence, the means by which Charles raised money, the question of Ship Money, and the meeting of the Long Parliament.

10. *School Management.*—Chap. X. 'Scholarship School Management.' Prepare answers to questions at end of book.

11. *Domestic Economy.*—Common accidents and their treatment; infectious diseases, their symptoms, periods of infection and quarantine, etc.

12. *Music.*—Revise any weak point, and answer questions below.

13. *French.*—Next 5 pages of 'Le Trésor.' Practise easy composition and rendering translations of the author back into French.

QUESTIONS TO BE ANSWERED.

1. Write as specimens of:—
(*a*) Large-hand:—
Li Hung Tchang.
(*b*) Small-hand:—
For therein stands the office of a king,
His honour, virtue, merit, and chief praise.

2. Analyse the following, and parse the words in italics:—
(*a*) *Go*, baffled *boaster!* teach thy haughty mood
To plead at thine imperious master's throne;
Say, thou hast left his legions in their blood,
Deceived his hopes, and frustrated *their own*.
Say that thine *utmost* skill and valour *shown*,
By British skill and valour *were outvied*.
Last, say thy conqueror was Wellington!
And if he *chafe*, *be* his own fortune tried;
God and our cause to friend, the venture will *abide*.

(*b*) *Well*, my lord,
If you *may* please *to think* I love the king,
And through him, *what* is nearest to him, which is
Your gracious self, embrace by my direction
(If your more ponderous and settled project
May suffer alteration), on mine honour,
I'll point *you* where you shall have *such receiving*
As shall become your honour.

(*c*) My house hath been my doom.
But *call* not *thou* this *traitor* of my house,
Who hath *but* dwelt beneath one roof with me.
My house are *rather* they who swore my vows,
Yea, *even while* they break them, owned *me king*,
And *well* for thee, *saying* in my dark hour,
When all the purport of my throne hath failed,
That *quick* or dead, thou holdest me for king.

3. Give examples from any poem you have read of (1) Simile; (2) Metaphor; and (3) Personification.

4. Say what a Passive Verb is, and how you recognise it, and give some examples of its use.

5. Give some account of Matabele Land and its people.

6. What do we receive from the West Coast of Africa, and what articles are imported there from England?

7. Point out the chief difficulties which Elizabeth had to overcome, and by what means she succeeded.

8. What evidence is there in the reign of James I. of the growing discontent of the Commons? What political plots were formed in his reign?

9. *Boys.*
(*a*) (i.) In dividing a number by 315, if I divide the number consecutively by 5, 7, 9, and obtain remainders 3, 2, 1, what is the complete remainder?
(ii.) Show that the ratios of two numbers may be expressed by a fraction.
(iii.) Make a diagram showing how a line or a cube may be divided in such a way as to prove the truth of the proposition $\frac{1}{3} - \frac{1}{4} = \frac{1}{3 \times 4}$.
(iv.) Work a sum in simple interest by the method of proportion, so as to show the truth of the shortened process which is commonly employed.
(v.) Explain clearly in what sense $1\cdot\dot{3}$ is represented by $1\frac{1}{3}$.
(*b*) What principal will amount to £42998·1696 in 8 years at 20 per cent. compound interest per annum?
(*c*) If the ratio of threepenny to fourpenny pieces in a given sum which consists entirely of those coins were altered from 3 : 7 to 7 : 3, the sum would be diminished by £20. Find the sum.
(*d*) Find the square root of 89820·09, and find the cube root of $16\frac{59}{728}$.
(*e*) A floor is half as long again as it is broad, and contains 13,824 square feet. Find the length of the shorter side, and the cost of flooring at 4½d. per square yard.
(*f*) A man makes 15 per cent. profit by selling 700 tons of coal for £1,006 5s. What would have been his profit per cent. and per ton if he had sold them for £936 5s.?
(*g*) A sum of £3,070 3s. 3d. has been divided between A, B, and C, so that A may have $\frac{3}{5}$ of $\frac{5}{8}$ of B's share, B $\frac{5}{7}$ of A's and C's together. Find their respective shares.

Girls.
(*a*) (i.) What is meant by 'rule of three direct' and the 'rule of three inverse'?
(ii.) Explain the rule for subtraction of vulgar fractions.
(iii.) What is meant by percentage and stock?
(iv.) Prove the rule for reducing a mixed circulating decimal to a vulgar fraction.
(*b*) If the carriage of 10 cwt. 14 lbs. for 79½ miles cost £7 17s. 6d. what will it cost to have 1 ton 1 cwt. 1 qr. conveyed the same distance?
(*c*) If 20 horses and 196 sheep can be kept for 9 days for £7 15s., what sum will keep 15 horses and 72 sheep for 8 days, supposing 5 horses eat as much as 76 sheep?
(*d*) Arrange in order of magnitude the fractions $\frac{7}{22}$, $\frac{355}{113}$, $\frac{113}{355}$, and express the difference of the first two as a fraction of the difference of the last two.
(*e*) A woman after spending $\frac{2}{5}$ of her money shopping, finds that $\frac{4}{7}$ of what she has still remaining is 1s. 9d. How much had she to start with?
(*f*) Add ·275 of a bushel to ·725 of a quarter, and find the value of the whole at 13s. 4d. per bushel.
(*g*) If ·2 of an acre of building land fetch ·15$\dot{6}$ of £198, what ought ·285714 of 7 acres to fetch at the same rate?

Answers—Boys.—(*a*) (i.) 48; (*b*) £10,000; (*c*) £185; (*d*) 299·7; $2\frac{8}{9}$; (*e*) 96 feet; £28 16s.; (*f*) 7 per cent.; 1s. 9d.; (*g*) A = £202 3s. $0\frac{4}{11}$d.; B = £1,364 10s. 4d.; C = £1,503 9s. $10\frac{10}{11}$d.
Girls.—(*b*) £16 10s. $6\frac{3}{4}$d.; (*c*) £4 2s. 8d.; (*d*) $\frac{7}{22}$, $\frac{113}{355}$, $\frac{106}{333}$; $16\frac{3}{42}$; (*e*) 5s. $1\frac{1}{4}$d.; (*f*) £4 1s.; (*g*) £279.

10. What is the range of temperature for cold and hot baths respectively? What precautions are necessary in the fixing of a bath as to filling, emptying, and overflow?

11. Supposing a person should be taken ill with an infectious disease, what steps would you take to prevent the disease from spreading?

12. *Music.*

(1) Write plainly the following values in four-pulse measure. The figures show duration in pulses or fractions of a pulse. Begin on a strong pulse :—

1/2	1/2	1/2	3/4	1/4	1/2	1/2	1	1/2	1/2	1/2	3/4	1/4	1	2	1
m	f	l	r	s	f	REST	m	r	f	s	f	m	r	d	REST

(2) Name the following intervals :—

f–f', m–l, f–de', r–se', d–re, r–ta, fe–ra', ra–de'

(3) Re-write the following, making a change by bridge notes at (*a*), and a return to the original key at (*b*).

	(*a*)								(*b*)					
d	m	l	r	s	fe	l	d'	m	r	fe	t	l	d	f	r	m	d

	(*a*)									(*b*)				
s	d	m	d'	ta	l	r'	s	ta	m	s	f	l	s	t	d'

(4) Write the Minor Scale ascending, using the minor 6th and the major 7th ; and again descending, using the minor 7th and the minor 6th.

(5) Which of the following notes is highest in pitch, and which lowest ?—

f' in Key C ; r in Key G ; m, in Key B♭ ; r, in Key A ; s, in Key D ; s, in Key F ; m' in Key E.

(6) Explain (briefly) the following terms : Legato, Fortissimo, Mezzo Forte, Leggiero, Accelerando, Lento, Presto, Crescendo.

CORRESPONDENCE.

1. Individual assistance will be given as far as possible by advice, solution of difficulties in any subjects, model answers, etc.
2. Specimens of Writing, Paraphrasing, Maps, Composition, etc., will be marked and criticised gratis.
3. To assist students in rural districts, Freehand or Model Drawings will be corrected and marked, with hints for improvement, etc., and returned if accompanied by a postage stamp.
4. As a rule, all replies will appear in the Correspondence Column, but anyone desiring an immediate reply may obtain it by enclosing a stamped addressed envelope.
5. To ensure an answer in the next issue queries must be sent by the 15th of each month.
6. Name and address of sender, with coupon of current number of the PRACTICAL TEACHER, and *nom de plume* if desired, must be enclosed.

All communications and queries with regard to the PUPIL TEACHERS' AND SCHOLARSHIP COURSE should be addressed to 'A. T. FLUX, 12, Lower Park Road, Belvedere, Kent.'

ANSWERS TO CORRESPONDENTS.

RIVERSIDE.—Your map is fairly good, but the printing needs attention ; you use capital letters throughout. This should not be. Plain block lettering for capitals, and Roman type for small letters. The mountains, if not carefully and neatly shaded (and this takes some time), should be marked by a thick black line. A neat border in ink always adds to the appearance of a map.

M.A.S.—The syllabus for the '97 Scholarship will probably not be published till January next. You can obtain one gratis and post free from 'The Secretary, Education Department, Whitehall, London, S.W.' I do not know any questions in French, except such as are given in the usual text books.

W. MARTIN.—You are quite right, but you have not finished. Ratios are always expressed in whole numbers, thus—

62½ : $51\frac{9}{16}$, multiplied by 16 to clear of fractions =
1000 : 925 and cancelling by 25 =
40 : 33. The answer given.

M.A.T.—Writing improved, but much practice still required ; 50/60. Arithmetic better in arrangement. I should advise you to work by method of unity and not proportion, though you should understand both.

J.E.L.—A very good essay, marks 50/60. Writing too stiff and angular ; the small hand especially needs attention. Marks 30/40.

J.P.—A very good essay. Marks 55/60. Do not sacrifice clearness of expression for the sake of introducing long words.

A.F.P.—There is no translation of 'Le Trésor' published.

DIAMONDS.—I do not know whether it will be possible, but I will ascertain during the next week or two.

ANSWERED BY POST.—E.T. (Pontymister); M.J. (Newport); E.D.; Despondent ; A.F.P. (Brighton); E.M.H. (Staines); P.L. (Whitstable); A.B. (Fleetwood); G.S.M. (Bristol); E.R.T. (Ivybridge); J.T. (Sheldon); R.P. (Braintree); G.N.R. (Langley); R.W. McL. (Stornoway); T.J.W. (Wigton); H.H.P. (Weymouth); E.C. (Ashton); G.L. (Liverpool).

RESULTS OF THE PUPIL TEACHERS' PRIZE COMPETITIONS

1.—MAPPING.

IN this competition there were many excellent maps submitted evincing much care and application. The Prize of **One Guinea** is awarded to JULIA REDFERN, Burn Cross Board School, Sheffield, but special commendation is due to 'Africanus' and 'Primus A1.' The remainder are classified as under :—

First Class.—Jennie, Puns, Prenez le tout, Busy Bee, Calliope, Bertram Eugene, Netley, Agricola, and Jean.

Second Class.—Honeysuckle, Spero 4, Premiére, Hereward, Practical, Faith, Doreen, Riverside, Excelsior, Karl, Granta, Poppy, Ameer Ali, 91, Neathonian, Ivan.

Third Class.—Decimus, Clematis, Vulcan, White Heather, Perseverance, Perseverance I., Ivy, Swanhied, Endeavour, Endymion, Counterpoint, Sigrid, Sweet Lavender.

General Remarks.—By far the weakest point in the majority of cases is the printing. The names should be kept horizontal as far as possible, the letters should be perfectly regular, and different styles used for names of towns and names of countries. Plain block lettering is better than Roman, which takes much time, and if not properly finished presents an untidy appearance. The printing should be vertical. In several cases marks were lost through the colouring, which was altogether too glaring. The lightest of tints is all that is necessary. Taken on the whole, the maps are very satisfactory, but there are many pupil teachers who have from time to time sent in maps for criticism who would have stood a good chance had they not apparently been too diffident.

2.—NEEDLEWORK.

The Prize of **One Guinea** is awarded to JANETTA RILEY, St. James's Girl School, Quarry Road, Tunbridge Wells, but 'Una' and 'Lily of the Valley' sent in specimens deserving of the highest praise.

First Class.—Espérance, Westmerian, Infelice, Spero, Practical, Brunette, Annie, Lassie, Rich Lee, Despondent, Pansy, Institute Pupil, Lois, Hazel, Myrtle, Violet, Æneid, Abertawe.

Second Class.—Hope, Lassie, Villette, Bluegown, Alpha, Swanhied, Currer Bell, Latrigg, Maidenhair Fern, Beta, Eta, Box, M.I.R., Nemo, A Pickles, Hopeful, Peggoty, and April.

Third Class.—Heather, Topsy, Mona, Perseverance, Caradoc.

General Remarks.—The whole of the specimens, with two or three exceptions, were extremely well done. In some few cases the work was not so clean as it should be, but with this exception there are practically no general faults.

3.—ESSAY WRITING.

The result of this competition is very disappointing. Very few essays were submitted, and the majority of those were of a poor character. This exemplifies what has so often been said in these columns, that Composition, which is of primary importance in all written examinations, is generally the weakest subject with pupil teachers. If the average candidate is afraid of meeting with very superior competitors in this exercise, we can assure him that he is mistaken.

In view of the small number of Essays submitted, it has been decided to allow the competition to remain open for another month, and we hope to receive a much larger number of papers.

A Prize of **One Guinea** is offered for the best Original **Essay** on either of the following two subjects :—(1) 'MY CHIEF DIFFICULTY IN TEACHING, AND HOW I MEET IT'; (2) 'MY FAVOURITE AUTHOR.'

(The Essays not to exceed two foolscap pages.)

CONDITIONS.

1. The competition is open to Pupil Teachers and Scholarship Candidates only.
2. Each exercise must be accompanied by the Coupon of the September issue of the PRACTICAL TEACHER, by a certificate from the Head Teacher, that the work is the unaided effort of the candidate, by an envelope containing the *nom de plume*, name, school address, and year of the candidate, and the *nom de plume* must be written on Essay submitted.
3. Essays to be sent to the Office of this Journal, marked 'P.T. Prize Competition,' on or before September 15th, and the result will be announced in the October number.

EDUCATION DEPARTMENT.

THE VISION OF CHILDREN IN LONDON ELEMENTARY SCHOOLS.

BY WALKER OVEREND, M.A., M.D. (OXON), B.SC. (LONDON),

Physician to the Tottenham Hospital;
Late Radcliffe Fellow, Scholar of Balliol College, and Exhibitioner in Comparative Anatomy of the London University.

MR. BRUDENELL CARTER, assisted by Mr. Hickman, has just presented to the Education Department a report on the vision of 8,125 children attending London elementary schools. A preliminary examination was made by the teachers, under Mr. Carter's direction, by means of revolving discs which displayed four letters of different size at one time. As a result 3,181, or 39 per cent., were found to possess normal eyesight in both eyes. The remainder were more completely examined by the authors themselves.

The eye is comparable to a camera or dark chamber, since it possesses an optical combination (the most important factor of which is the crystalline lens), adapted to form images on a sensitive screen or retina at the opposite extremity of the eyeball. With the distance of objects, the optical combination must vary in strength, otherwise the images will become blurred, and therefore indistinct. It is obvious that the power must increase as the object is brought nearer to the eye. A departure from normal vision may exist in two directions—the antero-posterior diameter or axis of the eyeball may be shorter than normal (hypermetropia), or it may be longer (myopia). Hypermetropia must be regarded as a condition of imperfect development. The axis of the eyeball being too short implies that the eye, as a whole, is small; and when the condition is extreme, it is often associated with an imperfection in the sensitiveness of the retina itself. In this country the great bulk of the population is hypermetropic to some degree, and the same state of things is almost universal in childhood. But as the child grows, the eyeball enlarges and attains more correct proportions. Errors of refraction are expressed in terms of dioptres. A dioptre is a lens (concave or convex as the case may require) of one metre focal length, and the number of such convex lenses necessary to correct the hypermetropia in any given case, is taken as the measure of its amount. When the eye is directed from a distant object to one which is near, the refractive power is increased by means of a special mechanism which renders the lens more convex. This change invokes a muscular effort, and is, in fact, accomplished by means of the ciliary muscle which lies within the eyeball. A dioptre is generally equal to one-third of a millimetre, and an eye with hypermetropia equal to three dioptres, must be one millimetre shorter than the normal eye. Accommodation may also be expressed in dioptres, and the ciliary muscle can exert a degree of accommodation equal to ten dioptres and maintain this for a considerable time. When hypermetropia is not more than three dioptres, the accommodation excited by the ciliary muscle is often continuously exerted to this extent, and the hypermetropia becomes concealed or 'latent.' The subject appears to possess normal eyesight until his power of accommodation becomes weakened by illness or old age. The power of accommodation may be suspended for a few hours by means of drugs, as belladonna, dropped into the eye or taken by the mouth in sufficient doses. When hypermetropia amounts to seven dioptres, the ciliary muscle is liable to cramp or fatigue, especially if much close work has to be done. Eyestrain, due to cramp of the muscle, and headache, is not uncommon in children from this cause.

The opposite condition, or myopia, requires to be corrected by means of concave glasses. The axis of the eyeball is too long, the convexity of the lens relatively too great, necessitating its diminution for perfect vision. This elongation may be congenital, that is, inherited from birth, or it may be acquired. In the latter case it may increase with the age of the child, in other words it may become *progressive*. Such increase is more likely to occur when much close work of the eyes has to be done in an imperfect light. The obvious disadvantage of myopia is that the extent of vision becomes diminished, and the power of observation is curtailed. When the myopia is not more than 2·5 dioptres, candidates are accepted for the Government services.

The authors determined the refraction by means of the ophthalmoscope. On looking into the eye, through the pupil, and turning a disc provided with lenses, one is at last able to obtain a clear view of the retina, and the lens used expresses the amount. In the first place the accommodation apparatus was paralysed by a one per cent. solution of hydrobromate of homatropia. Of the children examined by the authors, about sixty-one per cent. presented hypermetropia in both eyes, and of these four per cent. were over four dioptres. Sixteen per cent. were myopic, or about seven per cent. of the whole 8,125 children.

Myopia in excess of 2·5 dioptres occurred in 51 children only. Much alarm has arisen in former years as to the existence of a progressive myopia in passing from lower to higher schools. Cohn, of Breslau, some time ago found 1·4 per cent. of the children in village schools were myopic, 6·7 per cent. in elementary schools, 10 per cent. in middle-class schools, and 26 per cent. in gymnasia schools, and pointed out that the number of short-sighted children increases with the age. Cohn's observations have been extended and corroborated by other observers. Our country fares better, and it has been suggested that the broad low face of the German contains the condition for the production of myopia, while the long, narrow face of the English and Americans disposes towards hypermetropia. Mr. Carter has no hesitation in saying that the cases of myopia of low degree, that is, less than 2·5 dioptres, are due to imperfect formation and exhibit no signs of having been produced by school-work, or of being on the road to increase. There can be no doubt that in so far as myopia might be produced by school-work, girls would suffer more than boys, but such is not the case. Mr. Carter, however, proposes to re-examine the selected cases after a year's lapse of time, to ascertain the existence, or otherwise, of a progressive myopia.

Astigmatism is that condition where the curvature of one meridian of the eye differs from another. There is a longer radius in some one direction than in a direction at right angles to the same. The meridian of least curvative is usually horizontal, and one may be hypermetropic, the other may be normal or myopic. Astigmatism in some degree was found in about 10 per cent.

One fact comes out predominant, that the use of vision for near objects is becoming continual in town children, and that for distant objects only occasional, since the visual power of the children for distance is not cultivated. In a general review the authors conclude that the eyes of children are not injuriously affected by the conditions of elementary school life. The most preponderating condition is one of hypermetropia of moderate amount only, such as is easily overcome by the active accommodation of the ciliary muscle aided by the soft and yielding state of the lens in early life.

THE RÖNTGEN RAYS IN GERMINATION.—Schöber has recently undertaken some interesting experiments as to the effect of the X-rays on the germination of the oat. They differ from ordinary light rays in his opinion in that they have no power of producing heliotropic curvature, even in organs so sensitive to light as the axis of a young seedling.

***

A NEW REMEDY FOR BEE-STINGS.—A new remedy for bee-stings comes from Baroda. A physician there was attacked by a swarm of bees, and so severely stung on the hands, neck, and face, that one hundred and fifty stings were extracted from his neck alone. Both the swelling and the pain were greatly reduced by a paste made of ipecacuanha powder being smeared over the affected parts.

***

A NEW OXIDISING SOLUBLE FERMENT.—In a recent number of the *Comptes Rendues*, Bertrand states that the changes in colour produced by exposure of the juice of beet, potato tubers, and other vegetables to the air, are due to the oxidation of tyrosin under the influence of a soluble ferment, which he proposes to call tyrosinase. It is found naturally associated with tyrosin in numerous instances, as in the beet-root, dahlia, etc., whilst also occurring in several fungi not containing tyrosin.

Our Science Section.

☞ **Subscribers requiring Explanations of Difficulties in any Branch of Science, or Advice upon Courses of Study, can obtain all help required by communicating with the Editor, and accompanying their query with the Coupon cut from this No.**

MATHEMATICS.

STAGES 2 AND 3, SCIENCE AND ART DEPARTMENT.

BY G. A. BAXANDALL,
Assistant Mathematical Instructor, Royal College of Science, London.

STAGE 2.

Algebra.

Surds.

Read—Chapter XXIV. H.S., *or* Chapter XXXI. H.K.

In the first-mentioned chapter the articles of chief importance are Arts. 293, 297, 300 to 308, 315, 316, 317; of these probably the most important are Arts. 301, 307, 308, and 316.

The examples which are worked in the articles should receive careful attention.

In Chap. XXXI. H.K., the articles of chief importance are Arts. 258, 259, 262, 263, 265, 266, 270 to 273, 278; of these probably the most important are Arts. 266, 270, 278.

Each of the expressions, $\sqrt{x}+\sqrt{y}$ and $\sqrt{x}-\sqrt{y}$, is a *surd*, but their product, $x-y$, is *rational*: on this account each expression is said to be *conjugate* to the other. The operation of multiplying together two such numbers has very frequently to be performed, especially when it is required to simplify the form of a given fraction whose denominator is a surd. Thus

$$\frac{7-4\sqrt{3}}{7+4\sqrt{3}}=\frac{(7-4\sqrt{3})}{7+4\sqrt{3}}+\frac{7-4\sqrt{3}}{7-4\sqrt{3}}=97-56\sqrt{3},$$

the value of which can readily be obtained if the value of $\sqrt{3}$ be known.

In this way we are said to *rationalize* the denominator.

Work the following examples:—

13. Show that

$$\sqrt{147}+\sqrt{12}-2\sqrt{48}+3\sqrt{27}-2\sqrt{75}=0.$$

14. Find the square of—

$$\sqrt{\sqrt{15}-\sqrt{11}}+\sqrt{\sqrt{15}+\sqrt{11}}.$$

Ans. $4+2\sqrt{15}$.

15. Simplify the expressions—

$$\left(\sqrt{x}+1+\frac{1}{\sqrt{x}}\right)\left(\sqrt{x}-1+\frac{1}{\sqrt{x}}\right)$$

$$\frac{1}{\sqrt{a}+\sqrt{b}}+\frac{1}{\sqrt{a}-\sqrt{b}}+\frac{2}{a-b};$$

$$\frac{3+4\sqrt{3}}{\sqrt{6}+\sqrt{2}-\sqrt{5}}.$$

Ans. $\frac{1+x+x^2}{x}$; $\frac{2(1+\sqrt{a})}{a-b}$; $\sqrt{6}+\sqrt{2}+\sqrt{5}$.

16. Find the value of—

(1) $\frac{\sqrt{1+x}+\sqrt{1-x}}{\sqrt{1+x}-\sqrt{1-x}}$ when $x=\frac{2a}{a^2+1}$. Ans. $\frac{1}{a}$.

17. Show that—

$$\frac{2+\sqrt{3}}{\sqrt{2}+\sqrt{2+\sqrt{3}}}+\frac{2-\sqrt{3}}{\sqrt{2}-\sqrt{2-\sqrt{3}}}=\sqrt{2}.$$

18. Find the value of $\frac{1}{4-\sqrt{3}}$ to 6 decimal places.

Ans. ·440927.

19. Extract the square root of $18-8\sqrt{5}$.

Ans. $\sqrt{10}-2\sqrt{2}$.

Trigonometry.

Read—Chap. XIV. H.S., *or* Chap. XIV. Lock.

The proofs of the rules in Arts. 147 to 150 in H.S., and in Art. 193, Lock, should be carefully studied.

From either of the above chapters the student should obtain certain ideas to which we briefly allude here.

1. If $m=a^x$, then x is *defined* to be the *logarithm* of the *number* m to the *base* a; this is expressed by $x=\log_a m$. These two equations are of fundamental importance, and it is absolutely necessary that the student should practise the step from one equation to the other. For example—

If $n=b^y$ then $y=\log_b n$;

,, $r=c^d$,, $d=\log_c r$;

,, $mn=\left(\frac{x}{y}\right)^z$,, $z=\log_{\frac{x}{y}} mn$,

and so on.

2. Since $64=2^6$, $64=4^3$, or $64=8^2$, the logarithm of 64 is 6, 3, or 2, according as the base is 2, 4, or 8. That is, the logarithm of any number depends on the particular base which is chosen.

3. For convenience 10 is taken as the base. Since $100=10^2$ and $1{,}000=10^3$, the logarithms of 100 and 1,000 are 2 and 3 respectively. Also, if we have given that $\log 250=2{\cdot}39794$, then by raising 10 to the power 2·39794, we should obtain 250.

4. Referring again to log 250, the integral part 2 and the decimal part ·39794 are respectively called the *characteristic* and *mantissa*. But since 250 lies between 100 and 1,000 it is known that its logarithm must lie between 2 and 3, hence it is unnecessary to give the characteristic. The decimal portions are accordingly sometimes given alone.

Example.—Prove that $\log_a m=\log_a b\times\log_b m$.

Denote the three logarithms in order by x, y, z, then we have the two sets of equations—

$x=\log_a m$, therefore $m=a^x$,

$y=\log_a b$, ,, $b=a^y$,

$z=\log_b m$, ,, $m=b^z$.

Now we have to prove that $x=yz$, and this must be done by means of the equations to the right. Using the first and last of these, we deduce the equation

$$a^x=b^{yz},$$

which on using the middle one of the three becomes

$$a^x=(a^y)^z=a^{yz};$$

$$\therefore\ x=yz,$$

and $\log_a m=\log_a b\times\log_b m$.

Work the following Examples by the use of the logarithms given below, in which the mantissæ are only given. If the base be not mentioned, it must be taken as 10:—

22. Find (1) the characteristic of log 54 to base 3.

(2) log $(\cdot0125)\frac{1}{3}$. Ans. 3; $\bar{1}\cdot36564$.

23. Prove that $\log_a m=\log_a b.\log_b m$.

Given $\log 18=1{\cdot}255272$; and $\log 25=1{\cdot}397940$; find the logarithms of 5, 6, 3, 450, ·075, ·16.

Ans. ·698970; ·778151; 477121; 2·653212; 2·875061; $\bar{1}\cdot204120$.

24. Find the logarithms of 81 and ·00441.
Ans. 1·908485 ; $\bar{3}$·644438.

25. From log 76 = 1·880814, log 95 = 1·977724, deduce log 2 and log 19. Ans. ·3010300 ; 1·278754.

26. Find, to five places of decimals, the sixth root of ·163.
Ans. ·73909.

27. Prove that $\log a^m = m \log a$, and find log ·003125 in terms of log 2. Use logarithms to calculate the product of the tenth root of 5 by the fifth root of 10.
Ans. $-(1 + 5 \log 2)$; 1·861645.

28. Prove that $\log_a b \times \log_b a = 1$.

29. Find the logarithm of $\frac{5^4 \times 7^2}{9^3}$; and the value of $\sqrt[5]{315}$ to six places of decimals. Ans. 1·5233482 ; 3·159818.

30. Given $\log \frac{a}{b} = m$ and $\log \frac{b}{c} = n$, prove that $\log \frac{a}{c} = m + n$.

31. Find the value of $\sqrt{124 \times 125 \times 128}$ to three places of decimals ; and find the number of integer figures in the value of $(7·2)^{16}$. Ans. 1408·545 ; 14.

32. Prove that $\log_b N = \log N \times \log_b c$.

33. Prove that if m, n, and a, are any numbers,

$$\frac{\log_a n}{\log_{ma} n} = 1 + \log_a m.$$

34. Prove that $\log_{a^m} b \times \log_{b^n} a^m = 1$.

Given log 8 = ·9030900, log 28 = 1·447158 ; find the logarithms of 50 and 350. Ans. 1·69897 ; 2·544068.

35. Find the number whose logarithm is $-1·6805452$.
Ans. ·02086675.

It will have been observed that since the logarithm of unity is zero, the logarithm of every proper fraction is negative. Hence, since the sine and cosine of an angle are, in general, proper fractions, their logarithms must be negative. For convenience, however, it has been agreed to increase their logarithms by 10, and call them *tabular* logarithms. They are generally written L sin, L cos, L tan, etc., and sometimes log sin, log cos, etc. ; their numerical values for all angles may be found from a table of logarithms. For example—

$$\sin 30° = \tfrac{1}{2} ;$$

$$\therefore \text{ ordinary log. of } \sin 30° = \log \tfrac{1}{2}$$
$$= \bar{1}·6989700 ;$$

$$\therefore \text{ Tabular log. or L sin } 30° = \bar{1}·6989700 + 10$$
$$= 9·6989700.$$

Again, on taking logarithms in any equation, say,

$$\frac{\sin A \,.\, \cos B}{\sin C} = \sqrt{x},$$

we have log. of sin A + log. of cos B — log. of sin C = $\log \sqrt{x}$; therefore

$$(\text{L} \sin A - 10) + (\text{L} \cos B - 10) - (\text{L} \sin C - 10) = \tfrac{1}{2} \log x,$$

from which x could be found from a table of logarithms if A, B, and C were given.

If the logarithm be required for 15625·6, it may be found from the logarithms of 15625 and 15626. Similarly, if L tan 24° 6′ 16″ be required, it may be found from L tan 24° 6′ and L tan 24° 7′. The method which is employed in both these cases is an application of what is termed the principle of *proportional parts*. This involves a simple arithmetical calculation, and yet to many students it has proved to be a matter of considerable difficulty. Many illustrations will be found in Chap. XV. H.S., *or* Chap. XV. Lock.

The student should observe that the same principle is applied in every case, whether ordinary numbers or trigonometrical ratios occur. In each example of this character the required answer lies between two numbers which form part of the data. The student may determine merely by inspection to which of the two numbers the answer should be nearer, and after working the example he should check his answer in this manner ; this will often prevent errors.

Number.	Logarithm.	Number.	Logarithm.
2	3010300	31598	4996596
3	4771213	9	733
7	8450980	31	4913617
163	2121880	14085	1487569
739	8686440	6	877
40	7030	20866	3194392
18616	2698864	7	600
7	9097		

Stage 3.

Algebra.

Ex. 20 (*April*).

$$(6 - 7x + 2x^2)^{-1} = \frac{1}{6 - 7x + 2x^2}$$
$$= \frac{1}{(3 - 2x)(2 - x)}$$

$$\text{Let } \frac{1}{(3-2x)(2-x)} = \frac{A}{3-2x} + \frac{B}{2-x}$$
$$= \frac{2A - Ax + 3B - 2Bx}{(3-2x)(2-x)}.$$

Since the numerators on both sides are equal we must have

$$2A + 3B = 1,$$
$$-A - 2B = 0,$$

from which $A = 2$ and $B = -1$;

$$\text{hence } (6 - 7x + 2x^2)^{-1} = \frac{2}{3-2x} - \frac{1}{2-x}$$
$$= 2(3 - 2x)^{-1} - (2 - x)^{-1}.$$

The coefficient of x^r in each of these expansions should now be found and their difference taken.

Arithmetical Progression.

Read Arts. 448 to 458, Tod., or Chap. IV. H.K., omitting Art. 48.

One of the first difficulties is that of writing down the nth term of the series a, $a + d$, $a + 2d$, etc. It is not necessary to remember it, since it is a more useful exercise to write it down by observing the form of any particular term; thus the coefficient of d in the 3rd term is $(3 - 1)$ and in the nth term it will be $(n - 1)$, hence the nth term is $a + (n - 1)d$.

Ex.—Find the sum of 35 terms of the series whose pth term is $\frac{p}{7} + 2$.

Put $p = 1$, then the 1st term $= \frac{1}{7} + 2 = 2\frac{1}{7}$;
$p = 2$, ,, 2nd ,, $= \frac{2}{7} + 2 = 2\frac{2}{7}$;

hence the first term is $2\frac{1}{7}$ and the common difference is $\frac{1}{7}$, therefore the sum can now be found.

Ex. If $s = n(5n - 3)$ for all values of n, find the pth term.

Put $n = 1$, then the sum of 1 term $= 1(5 - 3) = 2$;
$n = 2$, ,, ,, 2 terms $= 2(10 - 3) = 14$;

hence the first term is 2 and the second is 12, therefore the common difference is 10. Accordingly the pth term is

$$2 + (p - 1)10 = 10p - 8.$$

Work the following examples :—

21. The sum of ten terms of a certain arithmetical series, from the eleventh to the twentieth inclusive, is 320 ; and the tenth term is to the thirteenth as 7 to 9: find the first term and the common difference. Ans. 3 : 2.

22. The sum of the first 10 terms of an arithmetical series is to the sum of the first 5 terms as 13 is to 4. Find the ratio of the first term to the common difference. Ans. 2 : 1.

23. There are $2m + 1$ terms in A. P. The first term is a, and the last is b ; what is the middle term ?
Ans. $\frac{a+b}{2}$.

24. If the common difference is $-d$, and the sum of n terms $\frac{(2a + d)^2}{9d}$, find n. Ans. $\frac{2(3a + d)}{3d}$ or $\frac{2a + d}{3d}$.

Geometrical Progression.

Read Tod. Arts. 448 to 458, or Chap. V., H.K.

It may be that a given series, although not a G.P., will split up into two geometric series, thus—

$$\frac{2}{3}+\frac{3}{3^2}+\frac{2}{3^3}+\frac{3}{3^4}+\ldots\ldots \text{ to infinity}$$

$$=\left(\frac{2}{3}+\frac{2}{3^3}+\frac{2}{3^5}+\ldots\ldots \text{ to infinity}\right)$$

$$+\left(\frac{3}{3^2}+\frac{3}{3^4}+\frac{3}{3^6}+\ldots\ldots \text{ to infinity}\right),$$

each of which is a G.P.

The type of series in Art. 473, Tod., or Art. 60, H.K., is an important one. Each term of these series consists of two factors, and the first factor of each term be taken an A.P. is formed, while a G.P. is formed by taking the second factors.

The sum of such a series is always found by multiplying the series by the common ratio of the G.P., and subtracting the result from the given series in the particular manner indicated in the articles referred to.

The series $1+\frac{3}{4}+\frac{7}{16}+\frac{15}{64}+\frac{31}{256}+\ldots\ldots$ to infinity is of a slightly different type, for while the factors $1, \frac{1}{4}, \frac{1}{16}, \frac{1}{64}, \frac{1}{256}, \ldots\ldots$ are in a G.P., the factors $1+3+7+15+31+\ldots$ do *not* form an A.P. But the sum may be effected in a similar manner.

$$\text{Let } S=1+\frac{3}{4}+\frac{7}{16}+\frac{15}{64}+\ldots\ldots$$

Multiply by $\frac{1}{4}$, the common ratio of the G.P.;

$$\text{then } \frac{S}{4}= \quad \frac{1}{4}+\frac{3}{16}+\frac{7}{64}+\ldots\ldots;$$

$$\therefore \frac{3}{4}=1+\frac{2}{4}+\frac{4}{16}+\frac{8}{64}+\ldots\ldots;$$

which is a G.P., first term 1, common ratio $\frac{1}{2}$; hence S may be found.

In some cases the series obtained after the first multiplication requires multiplying, again when a series is obtained, the sum of which may be readily found. As an example the student may sum the series $1+3x+6x^2+10x^3+\ldots\ldots$ to infinity.

Work the following :—

25. Find five numbers in geometrical progression such that their sum shall be 124, and that the quotient of the sum of the first and last by the middle term shall be $4\frac{1}{4}$.

Ans. 4, 8, 16, 32, 64.

26. A number consists of 3 digits in geometrical progression. The sum of the right-hand and the left-hand digits exceeds twice the middle digit by unity; and the sum of the left-hand and middle digits is two-thirds of the sum of the middle and right-hand digits. Find the number. Ans. 469.

27. If a, b, c, d are in geometrical progression,

$$a : b + d :: c^3 : c^2d + d^3.$$

28. If a, b, c, d be in geometrical progression, show that c^2+d^2 is greater than b^2+c^2.

Harmonical Progression.

Read Arts. 61 to 65, H.K., or Arts. 474 to 479, Tod.

Work the following examples :—

29. In an arithmetical progression the first term is 81, and the fourteenth is 159. In a geometrical progression the second term is 81, and the sixth is 16. Find the harmonic mean between the fourth terms of the two progressions. Ans. $52\frac{1}{2}$.

30. If a, b, c are in arithmetical progression, b, c, a in geometrical progression, prove that c, a, b will be in harmonical progression.

31. If $\frac{a+b}{2}, b, \frac{b+c}{2}$ be in harmonical progression, shew that a, b, c are in geometrical progression.

Trigonometry.

Ex. 23 (*April*). See Loney, Art. 222.

Ex. 24 (*April*). If a, b, c are in A.P., then $a+c=2b$. Hence $s=3b$ and $s-c=\frac{3b}{2}$. Substitute this value of s in the expression for Δ given, that is, $\sqrt{s(s-a)(s-b)(s-c)}$.

Ex. 19 (5) (*April*). Show that $ar_2r_3=S(r_2+r_3)$. Divide by r_2r_3, then prove that

$$a=S\left(\frac{1}{r_3}+\frac{1}{r_2}\right).$$

$$\text{R. H. S.}=\frac{S}{r_3}+\frac{S}{r_2}=s-c+s-b=a.$$

Read Arts 223, 224, 225, Loney, or Arts. 255 to 258, Tod.

Work the following :—

25. If a regular pentagon and a regular decagon have the same perimeter, prove that their areas are as $2 : \sqrt{5}$.

26. Compare the areas and perimeters of octagons which are respectively inscribed in and circumscribed to a given circle, and show that the areas of the inscribed hexagon and octagon are nearly as $\sqrt{27}$ to $\sqrt{32}$.

Ans. $2+\sqrt{2} : 4 ; \sqrt{2}+\sqrt{2} : 2$.

27. Show that the area of a regular polygon inscribed in a circle is a mean proportional between the areas of an inscribed and a circumscribed regular polygon of half the number of sides.

28. Two regular polygons of n and $2n$ sides are described such that the circle inscribed in the first circumscribes the second; also the radius of the circle inscribed in the second is to that of the circle circumscribing the first as $3+\sqrt{3}$ is to $4\sqrt{2}$. Prove that $n=6$.

29. Squares are described externally on the four sides of a parallelogram, and the centres P, Q, R, S, of the squares thus formed are joined. Show that PQRS is a square whose area exceeds that of the parallelogram by one quarter of the sum of the squares described on the sides.

30. ABC is a triangle, having $a=3, b=4, c=5$. CN is the perpendicular from C on AB. Find the radii of the circles inscribed in the triangles ACN, BCN, also the distance between their centres. Ans. $\frac{3}{2}, \frac{4}{5}, \sqrt{2}$.

NOTES ON THEORETICAL MECHANICS.

ADVANCED AND HONOURS STAGES.

BY F. CASTLE, M.I.M.E.

In the preceding articles on statics, in dealing with forces and their measurements, what is called the *gravitation unit*, or weight of unit mass, has been used; thus the term 'a force of one pound' would mean a force that would by direct opposition support a pound of matter against gravity; but the numerical value of gravity (or 'g' as it is called) is different at different places on the earth's surface: its mean value at the equator is 32·088, and at any place in latitude $\theta°$ it is $32{\cdot}088\,(1+{\cdot}00513\sin^2\theta)$; at the poles this gives $32{\cdot}088\times{\cdot}00513=32{\cdot}252$; this unit, therefore, does not furnish a definite standard independent of locality; so that when used it becomes necessary to specify the place at which the determination is made. To obtain a definite standard, and which shall be independent of locality, what is called an *absolute unit* or *poundal* is used; that is, *the force which, acting on a mass of one pound for one second, produces in that mass a velocity of one foot per second.*

The average value of 'g' for the United Kingdom differs but little from 32·2; thus the measure of the weight of one pound is 32·2 poundals. In calculations where accuracy is not essential the easier number 32 is used; hence the British absolute unit of force is approximately equal to the weight of half an ounce; also as the work done by a force of one pound through the space of one foot is called a foot-pound, so the work done by a poundal through the same space is called a *foot-poundal* or *absolute unit of work.*

In the C.G.S. system, the absolute unit called a *dyne* is the force which, acting on a mass of one gramme, produces a velocity of one centimetre per second; and the work done by a dyne through the space of one centimetre is an *erg.* The C.G.S. system is of great importance; but as the questions set at the Examinations in Theoretical Mechanics involve only the British units, foot, pound, and second, respectively, it is not necessary in these notes to consider both systems.

The three *Laws of Motion* as presented by Newton are :—

Law I. Every body continues in its state of rest or of uniform motion in a straight line, except so far as it is compelled to change that state by force acting on it.

Law II. Change of motion is proportional to the acting force, and takes place in the direction of the straight line in which the force acts.

Law III. To every action there is always an equal and contrary reaction; or the mutual actions of any two bodies are always equal and oppositely directed in the same straight line.

The three laws just enumerated are of the utmost importance, and as the student proceeds with the subject, and observes carefully their applications, he will gradually discover their full import. It is only necessary in these notes to draw attention to the second law; from this law it will at once be seen that if any force generates motion, a double force will generate double motion, and so on. This follows from the fact that the change of motion produced is proportional to the acting force. It is better, however, for many purposes, to use change of momentum instead of change of motion, and impulse instead of acting force; thus the second law, in terms of impulse and momentum, may be rendered: *Change of momentum of a body is numerically equal to the impulse which produces it and is in the same direction.*

$\therefore M(v-u) = Ft$, (1) where v and u are the final and initial velocities respectively, t the time in seconds, and F the force in poundals. If unit time be taken, then $v-u$ gives the change in the magnitude of the velocity per second. This is called the acceleration, and denoting it by f, then $Mf = F$, or the *mass of the body in pounds multiplied by the acceleration is numerically equal to the force in poundals.* If the force, and therefore the acceleration, be uniform for a time, t, during which the velocity changes from u to v, the average velocity will be $\frac{1}{2}(v+u)$, and the space s described in a time t will be $\frac{1}{2}(v+u)t$.

$$\therefore t = \frac{2s}{v+u}.$$

Substitute this value of t in $M(v-u) = Ft$, (1) and we obtain $Fs = \frac{1}{2}M(v^2-u^2)$, (2) or the force in poundals multiplied by the space in feet is numerically equal to half the mass in pounds multiplied by square of the final velocity minus the square of the initial velocity.

Equations (1) and (2) are often termed the time and space action of a force respectively; also equation (2) gives the *kinetic energy* or accumulated work in a moving body; thus if a body moving with an initial velocity u has its velocity increased to v, then $\frac{1}{2}M(v^2-u^2)$ units of work must have been done by the force in altering its velocity, or if the velocity is gradually reduced by the action of resistances, the body, in virtue of its energy, will do against the resistances $\frac{1}{2}M(v^2-u^2)$ units of work.

If u be zero, the energy is $\frac{1}{2}MV^2$ absolute units, or $\frac{WV^2}{2g}$ gravitation units. The expression Fs is called the potential energy of the body.

1. A body of mass 10 lbs. is raised to a height of 30 ft.; what is the increase in its potential energy? If allowed to fall, what is the kinetic energy when it reaches the ground? (1893.)
Ans. 9,600 ft. poundals.

2. The mass of a particle is M lbs., and its velocity V ft. a second; find the number of foot-pounds of work it can do against a resistance.

A particle weighs 10 lbs., and moves at the rate of 1,250 feet a second; find the distance through which it could overcome a resistance of one million pounds. (1888.) Ans. ·24 ft.

$$\left(s \times 1{,}000{,}000 = \frac{10 \times 1250 \times 1250}{2 \times 32};\ \therefore s = \cdot 24 \text{ ft.}\right).$$

3. A particle slides along a rough horizontal plane; find the retardation of its velocity.

If the coefficient of friction between the particle and the plane is 0·05, and the velocity at a certain point 40 ft. a second, at what distance from the point will it come to rest, and after what time? (1885.) Ans. 500 ft., 25 seconds.

$$\left(\frac{W \times 40^2}{2 \times 32} = \cdot 05W \times s, \text{ etc.}\right)$$

4. A particle whose mass is 5 lbs. moves at the rate of 20 ft. a second; express its kinetic energy in foot-poundals. If it moves over a distance of 30 ft. against a constant resistance (R), and its velocity is thereby reduced to 15 ft. a second, find R in poundals. (1892.) Ans. 1000 and $14\frac{7}{2}$.

$$\left(\tfrac{1}{2} \times 5 \times 20^2, \text{ etc.}\right)$$

5. A bullet, moving at the rate of 1,100 ft. a second, passes through a thin plank, and comes out with a velocity of 1,000 ft. a second; if it then passes through another plank exactly like the former, with what velocity will it come out of this second plank? (1895.) Ans. 888·89 ft. per sec.

6. If a force P acts on a body moving from rest while it describes a distance b, show that $Pb = \frac{1}{2}Mv^2$. What are Pb and $\frac{1}{2}Mv^2$ called respectively? If b is reckoned in feet, M in pounds, and v in feet per sec., in what units must P be reckoned? (1883.)

State Newton's Second Law of Motion. Explain briefly how the measure of force is derived from this law.

In the equation $P = mf$, in what units is P, when the units of mass, distance, and time are a pound, a foot, and a second? (1896.)

7. A body, whose mass is 12 lbs., is found to gain a velocity of 15 ft. a second when acted on by a constant force (F) for 3 secs.; find F in poundals. Ans. 60.

(Gain of velocity = 5 ft. per sec. per sec.; $\therefore F = 12 \times 5 = 60$ poundals.)

8. A particle at a certain instant is moving at the rate of 800 yards a minute, and after 6 seconds at 55 ft. per sec., find the acceleration; find also the force if the mass be 12 ounces.
Ans. $2\frac{1}{2}$; $1\frac{7}{8}$.

(800 yds. per min. = 40 ft. per sec.: gain each sec. $= 2\frac{1}{2}$ ft., also force $= \frac{12}{16} \times 2\frac{1}{2} = 1\frac{7}{8}$ poundals.)

9. Define an absolute unit of force and a poundal. It is sometimes said that a poundal is half an ounce, or the weight of half an ounce; point out (*a*) the inexactness of the statement, (*b*) why the statement, even if exact, would not be a definition of a poundal. (1893.)

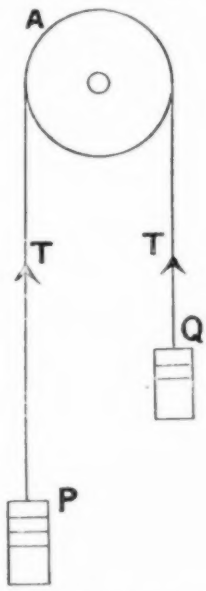
10. State Newton's Three Laws of Motion. Give his illustration of the Third Law of Motion. (1894.)

11. Define a poundal. The acceleration due to the attraction of a planet on a body near its surface varies as the mass of the planet directly and the square of its radius inversely. Find the force in a pound of matter at or near the surface of Jupiter; given that his mass is 370 times and his radius 11 times respectively that of the earth ($g = 32$.) (1894.) Ans. 97·85 poundals.

12. A body in motion is observed to increase its velocity in every second by $5\frac{1}{2}$ ft. per second. How far would it move from rest in 12 secs.? If the body has a mass of 10 lbs., what is the numerical value of the force producing the motion, (*a*) in absolute units, (*b*) in gravitation units ($g = 32$)? (1885.) Ans. $53\frac{1}{3}$ poundals; $1\frac{2}{3}$ lbs.

The fundamental equation $F = Mf$ is often used to determine the acceleration produced in a moving system by a given force acting on a given mass, the equation is then written $f = \frac{\text{acting force}}{\text{mass moved}}$.

Let P and Q be two masses connected by a light string passing over a smooth point or pulley at A. Let P be the larger mass, and



let the tension of the string (which is assumed to be the same throughout) be denoted by T. Then on the mass P there are two forces acting—its weight Pg downwards and the tension T upwards; similarly at Q the forces are T and Qg.

The acting force will be $(P-Q)g$, and the mass moved $P+Q$; hence $f=\frac{P-Q}{P+Q}g$ (1), from which f is found when P and Q are known.

To get the tension T; since P is moving downward the acting force is $Pg-T$.

$$\therefore f=\frac{Pg-T}{P}.$$

Also Q is moving at the same rate as P, but upwards; or

$$f=\frac{T-Qg}{Q};$$

$$\text{hence } \frac{Pg-T}{P}=\frac{T-Qg}{Q}.$$

$$\therefore T=\frac{2PQ}{P+Q}g. \quad (2)$$

The following example will show how to use Equations (1) and (2):—

13. (*a*) Two particles, whose masses are P and Q, are connected by a thread, which is placed on a smooth point; if P goes down and draws Q up, find the acceleration of its velocity.

(*b*) Find the mass of P, when twice the tension of the thread equals three times the weight of Q. (1891.)

Equation (1) gives the solution to (*a*); (*b*) from Equation (2).

$$2T=\frac{4PQ}{P+Q}g;$$

$$\text{but } 2T=3Qg.$$

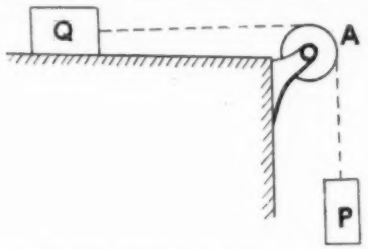
$$\therefore 3Qg=\frac{4PQ}{P+Q}g.$$

$$\therefore P=3Q.$$

14. Two bodies P and Q are connected by a fine thread passing over a perfectly smooth fixed horizontal cylinder; the mass of P is greater than that of Q; P is allowed to descend through a distance d drawing up Q; at the instant the distance has been described, part of P falls off, leaving P_1, the mass of which is less than that of P; find how far P_1 will descend. (1885.)

Ans. $\frac{(P_1+Q)(P-Q)}{(Q-P_1)(P+Q)}d$.

Two masses P and Q are connected by a light string. P hangs vertically, Q resting on a smooth horizontal table. To find the



acceleration f; the mass moved is $P+Q$. P is the force causing motion.

$$\therefore f=\frac{P}{P+Q}g. \quad (1)$$

If the table be rough and the coefficient of friction μ, then, as before, mass moved is $P+Q$, force causing motion is the excess of P over the force of friction μQ.

$$\therefore f=\frac{P-\mu Q}{P+Q}g.$$

If the acceleration be zero, or if P by a slight impulse started from rest is found to move at a uniform rate, the apparatus enables the coefficient of friction (between a body Q and the surface on which it rests) to be determined;

$$\therefore P-\mu Q=0, \text{ from which } \mu=\frac{P}{Q}.$$

In this manner the value of μ was determined by Morin (allowance being made for the friction of the pulley at A by a slight addition to P).

Let T be the tension in the string connecting P and Q, as the acceleration of Q is caused by the force T. $\therefore T=Qf$. Substitute the value of f in Equation (1).

$$\therefore T=\frac{PQ}{P+Q}g.$$

(*To be continued.*)

MODEL ANSWERS TO HONOURS STAGE, INORGANIC CHEMISTRY, 1896.

HONOURS EXAMINATION.

Instructions.

Read the General Instructions on page 1.
You are permitted to attempt only *six* questions.
Whenever possible, you are to express the reactions in equations.
You are to give such numerical details as will show the mode of calculation.

61. Describe the methods employed by Thomsen to determine the heat of neutralisation of acids and bases, and state the general results of his experiments. (64.)

By the heat of neutralisation of an acid by a base, or *vice versâ*, is meant the quantity of heat produced in mixing equivalent parts in grams of the acid and the base, in dilute aqueous solutions, the products of the solution being also soluble in water.

To determine this, Thomsen used a solution of NaOH (40 grams) in 100 grams of water in determining the heat of neutralisation of an acid, and in dealing with bases a solution $\frac{1}{2}H_2SO_4$ (49 grams) in 100 grams water.

The mixing was made in a properly arranged calorimeter, a description of which need not be given here, as full details of the experiment are given in Pattison Muir's 'Thermal Chemistry,' which book the Honours student must by no means omit to read.

Some of the results arrived at are as follows:—

(1) The heat of neutralisation of the commoner acids ranges from 10,000 to 15,000 calories.

A few of the more important of these are given in the list which follows:—

HCl	- - - -	13,740 calories.
HBr	- - - -	13,748 ,,
HI	- - - -	13,721 ,,
HNO_3	- - - -	13,617 ,,
$\frac{1}{2}H_2SO_4$	- - - -	15,690 ,,

(2) The thermal change is nearly but not quite proportional to the quantity of soda measured as 1, 2, 3, or 4 molecules, thus affording a test of the basicity of acids.

(3) In the case of the neutralisation of dibasic acids, it happens sometimes that the evolution of heat is greater in the case of the first molecule of sodium hydrate added, and sometimes greater on the addition of the second molecule. From this it is argued that the grouping of the elements in certain of these acids is different from what obtains in others. Thus sulphurous acid, where the heat of neutralisation is greater in the case of the first added molecule of soda than in the second, has been supposed to have the following composition:—

$$SO_2\begin{cases}OH\\H\end{cases}.$$

(4) It is argued that as the amount of energy in a system measures its stability, therefore when the evolution of heat is very great the compound is stable, and *vice versâ*.

(5) All spontaneous chemical changes tend towards the production of the body or system of bodies in the formation of which the greatest amount of heat is given out. This is the so-called principle of maximum work, which is in reality nothing more than an expression of the principle of the degradation of energy, viz., that energy always tends to run down from a more available to a less available form.

(6) The total thermal value of a reaction is dependent only on the initial and final changes of the changing system.

62. Describe the means you would adopt in order to prepare from sodium sulphite (*a*) sodium hyposulphite and (*b*) sodium thiosulphate. Discuss the existing evidence concerning the constitution of each of these three compounds. (72.)

To prepare sodium hyposulphite, $Na_2S_2O_4$, from sodium sulphite, we start with the acid sulphite $NaHSO_3$, and act upon this with Zn. Zn clippings are immersed in a concentrated solution of $NaHSO_3$, when the following reaction takes place:—

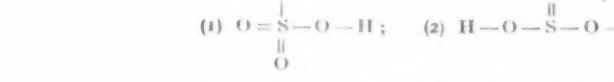
$$4NaHSO_3+Zn=ZnSO_3+Na_2SO_3+Na_2S_2O_4+2H_2O.$$

The supernatant liquid is decanted into a flask, and mixed with three or four times its volume of strong alcohol. The greater part of the Zn and Na sulphites still in the flask now crystallises out, and when the remaining liquid is decanted into another flask, corked, and allowed to stand for a time, a heavy crop of crystalline sodium hyposulphite results.

The usual method for preparing sodium thiosulphate $Na_2S_2O_3$ is by digesting Na_2SO_3 with solid S, when the following reaction takes place :—

$$Na_2SO_3 + S = Na_2S_2O_3.$$

The chief question in connection with the composition of H_2SO_3 and the sulphites is whether or no S is hexad or tetrad in these compounds. We may conceive of H_2SO_3 as a dibasic acid (1) with the acidic H in combination with O, as hydroxyl, and (2) with one H so combined, and with the other in combination with S, thus :—



In the former S is hexad, in the latter tetrad. Knowing how common isomerism is amongst carbon compounds, we may admit the possibility of the existence of two sulphurous acids, and as a matter of fact two kinds of sulphites differing in properties have been prepared. Admitting this isomerism as at least probable, the question arises as to the composition of normal sodium sulphite and normal sulphurous acid.

By means of organic radicles it is possible to replace one of the Na atoms of Na_2SO_3, whereby we get a compound, which from its behaviour indicates that *S and the radicle are in direct combination*. As this body is prepared by the direct displacement of the Na by S, this goes to prove that one of the sodium atoms is in direct combination with the S, and, if so, formula (1), in which S is a hexad, would represent normal H_2SO_3.

On the contrary, by acting upon $SOCl_2$ with water, we get H_2SO_3 and HCl.

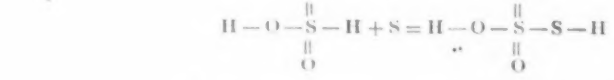
$$SOCl_2 + 2H_2O = SO(OH)_2 + 2HCl,$$

and this view is further strengthened by the fact that SO_2 readily forms H_2SO_3 with H_2O ; that H_2SO_3 readily breaks down into H_2O and SO_2, and that it so readily takes up O to form H_2SO_4, and S to form $H_2S_2O_3$.

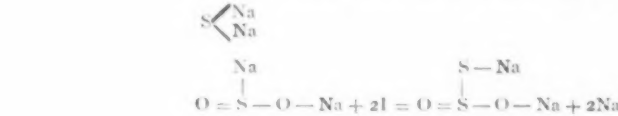
Against this are to be pitted the two points above referred to, viz., that the direct substitution of a radicle for Na gives a body in which we are all but certain that S and the displacing radicle are in direct union, and that S tends to behave as a hexad element.

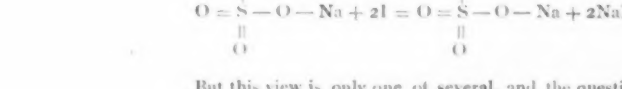
The present leaning of belief is in favour of the first-named formula.

$Na_2S_2O_3$ (sodium thiosulphate). Just as H_2SO_4 is formed by the addition of O to H_2SO_3, so $H_2S_2O_3$ is formed by the addition of S to H_2SO_3. The composition of this body then depends upon that of H_2SO_3, and may thus be represented :—



and this view is further corroborated by the preparation of $Na_2S_2O_3$ from the action of I and Na_2S on Na_2SO_3, thus :—





But this view is only one of several, and the question as to the constitution of $H_2S_2O_3$ is by no means settled.

Sodium hyposulphite, Na_2SO_2 or $Na_2S_2O_4$. The former is the formula used by Schützenberger, the discoverer of hyposulphurous acid, the latter, and more generally accepted formula, is due to Bernthsen.

The question is whether or no SO_3 or S_2O_3 is the anhydrid of this acid, *i.e.*, whether

$$H_2O + 2SO_3 = H_2S_2O_4,$$
$$\text{or} \quad H_2O + S_2O_3 = H_2S_2O_4,$$

represents the formation of this acid. The latter is accepted on the following evidence :—For every two atoms of S in the form of hyposulphite, one atom of oxygen is required to oxidise the substance to a sulphite, which may be effected by means of an ammonia solution of $CuSO_4$, and three atoms of O are required to oxidise it to a sulphate, a reaction which may be ensured by the use of a solution of iodine.

Both of these facts are in agreement with the formula $H_2S_2O_4$

$$\left.\begin{array}{ll} (1) & S_2O_3 + O = 2SO_2 \\ & 2SO + 2O = 2SO_2 \\ (2) & S_2O_3 + 3O = 2SO_3 \\ & 2SO + 4O = 2SO_3 \end{array}\right\}$$

63. Give a succinct account of the early experiments of Cavendish on the composition of the air, and of the further investigations of Lord Rayleigh and Professor Ramsay which led to the discovery of a new constituent of the atmosphere. (64.)

In the first place Cavendish made many analyses in order to find out by means of the eudiometer the difference between pure and vitiated air. He concluded that experiment could not show this difference, a fact which can easily be realised when it is remembered how wonderfully constant the composition of this mixture is.

In the second place Cavendish experimented on a mixture of air and oxygen standing over potash, in order to discover whether or no the whole of the nitrogenous, or, as he termed it, the phlogisticated parts of the atmosphere could all be reduced by oxidation to 'nitrous acid,' *i.e.* to nitric acid. It is here that the work of Cavendish comes into touch with that of Rayleigh and Ramsay, for he found that $\frac{1}{120}$ of a given volume of air could not be so changed, but remained uncombined, a result in close agreement with the determinations of argon, which is found to form about 1 per cent. of the atmosphere.

The first step towards the discovery of the new constituent was taken in 1894, when Lord Rayleigh discovered that nitrogen extracted from chemical compounds is about ·5 per cent. lighter than 'atmospheric nitrogen' obtained by passing air freed from moisture and CO_2 over heated copper or iron. To further prove this, complicated and lengthy experiments were undertaken to free the air from moisture, oxygen, hydrogen, and hydrocarbons, and from the gradual absorption of nitrogen. The following is the account of the isolation as told by Thorpe :

'Air is freed from oxygen by means of red hot copper, and the residue is then passed from a gas-holder through a combustion tube, heated in a furnace containing Cu in order to free from all traces of O ; the issuing gas is then dried by passage over soda lime and P_2O_5, after passing through a small U-tube containing H_2SO_4, to indicate the rate of flow. It next enters a combustion tube packed tightly with Mg turnings and heated to redness in a second furnace. From this tube it passes through a second index tube and enters a small gas holder capable of containing three or four litres. A single tube of Mg will absorb seven or eight litres of N.

'Having collected the residue from 100 to 150 litres of atmospheric nitrogen, which may amount to 4 or 5 litres, it is transferred to a small gas-holder connected with an apparatus whereby, by means of a kind of self-acting Sprengel pump, the gas is caused to circulate through a tube half filled with Cu and half with CuO ; it then traverses a tube half filled with soda lime and half with P_2O_5, and then passes into a vessel of about 300 c.c. capacity, from which it can be expelled into a small gas-holder. Next it passes through a tube containg Mg turnings heated to bright redness. As the amount of gas in the tubes and reservoir diminishes in volume, it draws supplies from the gasholder, and at last the circulating system is full of argon in a pure state.'

The two facts from which the distinction from N is argued are (1) the density, which is about 20, and (2) the spectrum, which consists of a large number of lines distributed over almost the whole visible field, two very characteristic lines being in the red, but less refrangible than the red lines of hydrogen or lithium ; another line in the yellow, more refrangible than the Na line, and three bright green lines make up the group of five, which are regarded as characteristic of the new constituent of the atmosphere.

(*To be continued.*)

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MAGNETISM.

1. Describe in detail the method of determining the magnetic dip at any point, explaining the reason for each operation you describe.

Answer.—The dip needle is mounted so that it is free to rotate about an horizontal axis through its centre and perpendicular to its length. The frame on which it is supported must be capable of rotation about a vertical axis. A graduated horizontal scale measures rotation about this latter axis, whilst a vertical scale placed in the plane of rotation of the needle measures its inclination to the vertical. The operations to be performed in determining the dip are then as follows:—

(*a*) The whole instrument is levelled by means of a spirit level fixed to the base of the instrument. The dip needle, with its supports and vertical graduated scale, is then turned till the needle is seen to hang vertically. The plane of rotation of the needle is then perpendicular to the magnetic meridian. The reading on the horizontal scale being noted, the instrument is twisted through two right angles till the needle is again vertical, and the reading on the horizontal scale again noted. The instrument is now twisted about its vertical axis till it is at right angles to the mean position of the two former experiments. The dip needle is now free to assume any position in the plane of the magnetic meridian.

(*b*) The reading of the two extremities of the dip needle are now noted on the vertical scale. Both readings are taken to avoid errors due to the axis of rotation of the needle possibly not passing through the centre of the graduated circle.

(*c*) The needle with its supports is now turned through exactly 180° about the vertical axis, and readings are taken at each end of the needle as before. This is to guard against the zero of the vertical scale not being exactly beneath the axis of rotation of the needle. Half the difference of the present reading and that before obtained gives the inclination of the needle to the vertical.

(*d*) The needle is now taken from its supports, and replaced with that end of its axis of rotation which was formerly pointing to the east, now pointing to the west. Observations such as (*b*) and (*c*) are now repeated. This experiment is intended to guard against the magnetic axis of the needle not coinciding with its axis of geometrical symmetry.

(*e*) If the needle was accurately made, so that when unmagnetised it would balance perfectly on its axis, these observations would be sufficient. But to guard against the possibility of one end of the needle being mechanically heavier than the other, it is taken from its supports and re-magnetized in the reverse direction. If readings similar to (*b*) and (*c*) and (*d*) are again taken, and the mean of the whole obtained, any error due to this cause will be eliminated.

2. Prove that the magnetic force exerted by a short magnet at a point A on the line passing through its centre and perpendicular to its axis, is the same as the force exerted at a point on the axis the distance of which from the centre of the magnet is $\sqrt{2}$ times the distance of A from the centre.

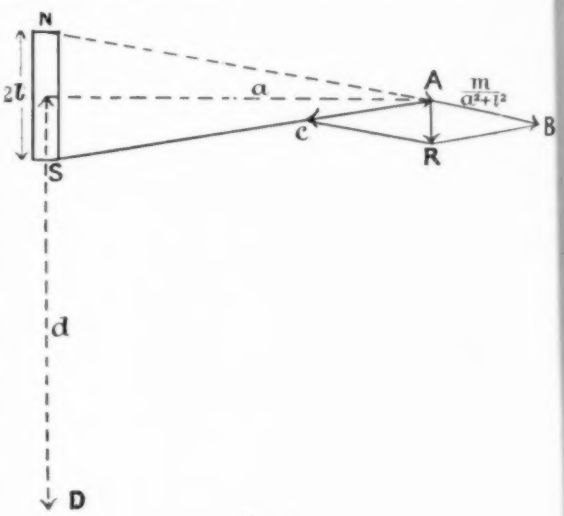

FIG. 1.

Answer.—Let NS represent the magnet, supposed of pole strength = m, and length = $2l$. Let the distance of the point A from the centre C of the magnet be a; then the force exerted on an unit N pole placed at A by the pole N will be

in the direction NA, and of magnitude = $\frac{m}{a^2 + l^2}$

Denote this force by the vector AB.

Similarly the force due to S may be denoted by the vector AC, also of magnitude $\frac{m}{a^2 + l^2}$

Completing the parallelogram AB RC, AR will denote the resultant of these two forces. Also

$$\frac{AR}{AB} = \frac{NS}{NA} = \frac{2l}{(a^2 + l^2)^{\frac{1}{2}}},$$

by similar triangles.

$$\therefore AR = AB \frac{2l}{(a^2 + l^2)^{\frac{1}{2}}} = \frac{2ml}{(a^2 + l^2)^{\frac{3}{2}}}. \quad (1)$$

Also the force at any point D on the axis of the magnet, distant d from the centre of the magnet, will be

$$\frac{m}{(d - l)^2} - \frac{m}{(d + l)^2} = \frac{4mdl}{(d^2 - l^2)^2} \quad (2)$$

For the force at A to be equal to that at D we must have

$$\frac{2ml}{(a^2 + l^2)^{\frac{3}{2}}} = \frac{4mdl}{(d^2 - l^2)^2}$$

Since the magnet is short, l^2 may be neglected in this equation.

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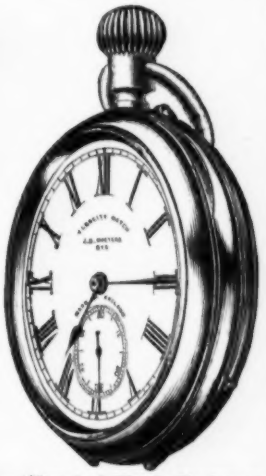

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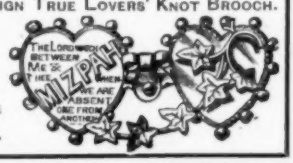

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$$\frac{1}{a^3} = \frac{2d}{d^4} = \frac{2}{d^3};$$

$$\therefore \frac{d^3}{a^3} = 2.$$

$$\therefore \frac{d}{a} = \sqrt[3]{2}.$$

3. A bar magnet is placed with its centre due east of a compass needle, and with its axis parallel to the magnetic meridian. How will you determine whether the intensity of the magnetic field at the needle is increased or diminished? Further, how will you compare the field with that which existed there before the bar magnet was brought near?

Answer.—Whether the intensity of the magnetic field, at the position of the compass needle, is increased or diminished by the presence of the bar magnet, may be determined in two ways:—

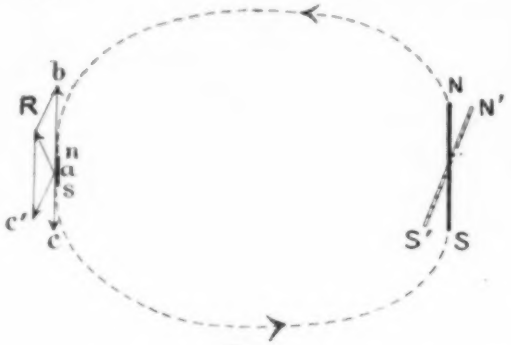

FIG. 2.

(*a*) The compass needle will, of course, lie along the lines of force. Let *ns* (Fig. 2) represent the position of the compass needle, NS that of the bar magnet. The lines of force will proceed from the bar magnet at first due north, but will gradually curl round till, at the position of the compass needle, they will be proceeding due south. It is supposed that the field produced by the bar magnet is not strong enough to reverse the earth's field. Let the vector line *ab* represent the strength of the horizontal component of the earth's field. Then a line *ac*, opposite in direction and less in magnitude than *ab*, will represent the field due to NS. The resultant field will be given in magnitude and direction by a line in the direction *ab*, whose length $= ab - ac$. The compass needle will still, then, point to the north.

Now twist the bar magnet NS through a small angle in the sense of the hands of a clock to N'S'. The field due to it at the centre of the compass needle will now be represented by a line *ac'*, equal in magnitude to *ac*, and parallel to N'S'. The resultant of this field and that of the earth can be found by completing the parallelogram *ac'*R*b*, and drawing the diagonal *a*R. This will be the new direction taken up by the compass needle, and it will be seen that whilst the bar magnet NS is twisted in the sense that the hands of a clock move, the compass needle will turn in the opposite sense.

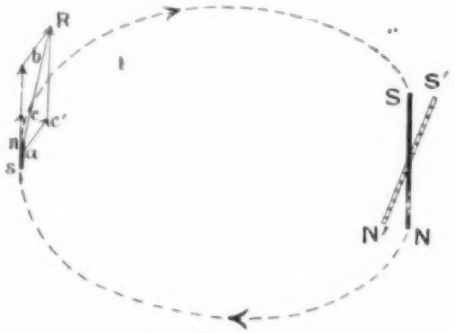

FIG. 3.

Now suppose the bar magnet to have the position SN (Fig. 3). In this case it is easily seen that it will tend to augment the intensity of the earth's field. If SN be twisted to S'N', its field at *a* will be represented by *ac'*, and completing the parallelogram *ac'*R*b'* as before, *a*R will be the resultant field. Since this is the new direction taken up by the compass needle, it is plain that the latter will in this case twist in the same sense as the bar magnet is twisted.

Therefore, to determine whether the earth's field is augmented or diminished by the bar magnet, all that is necessary is to twist the latter and note the sense in which the compass needle twists. If the sense of the two is the same the field is augmented; if the sense of the two differ the field is diminished.

(*b*) When a magnet oscillates in a field of strength H, the time of oscillation is given by the equation

$$t = 2\pi\sqrt{\frac{K}{MH}}.$$

If, therefore, placing the bar magnet due east increases the time of oscillation of the compass needle H, the field at the position of the latter must be diminished; if the time of oscillation is decreased, the field must be increased.

To find the relative magnitudes of the fields in the two cases, let H be the field before the bar magnet was placed in position, and t_1 the time of oscillation of the compass needle, H_2 and t_2 denoting similar quantities after the bar magnet was placed in position.

Then

$$t_1 = \sqrt{\frac{K}{MH_1}};$$

$$t_2 = \sqrt{\frac{K}{MH_2}};$$

$$\therefore \frac{t_1}{t_2} = \sqrt{\frac{H_2}{H_1}};$$

$$\therefore \frac{H_2}{H_1} = \frac{t_1^2}{t_2^2};$$

(*To be continued.*)

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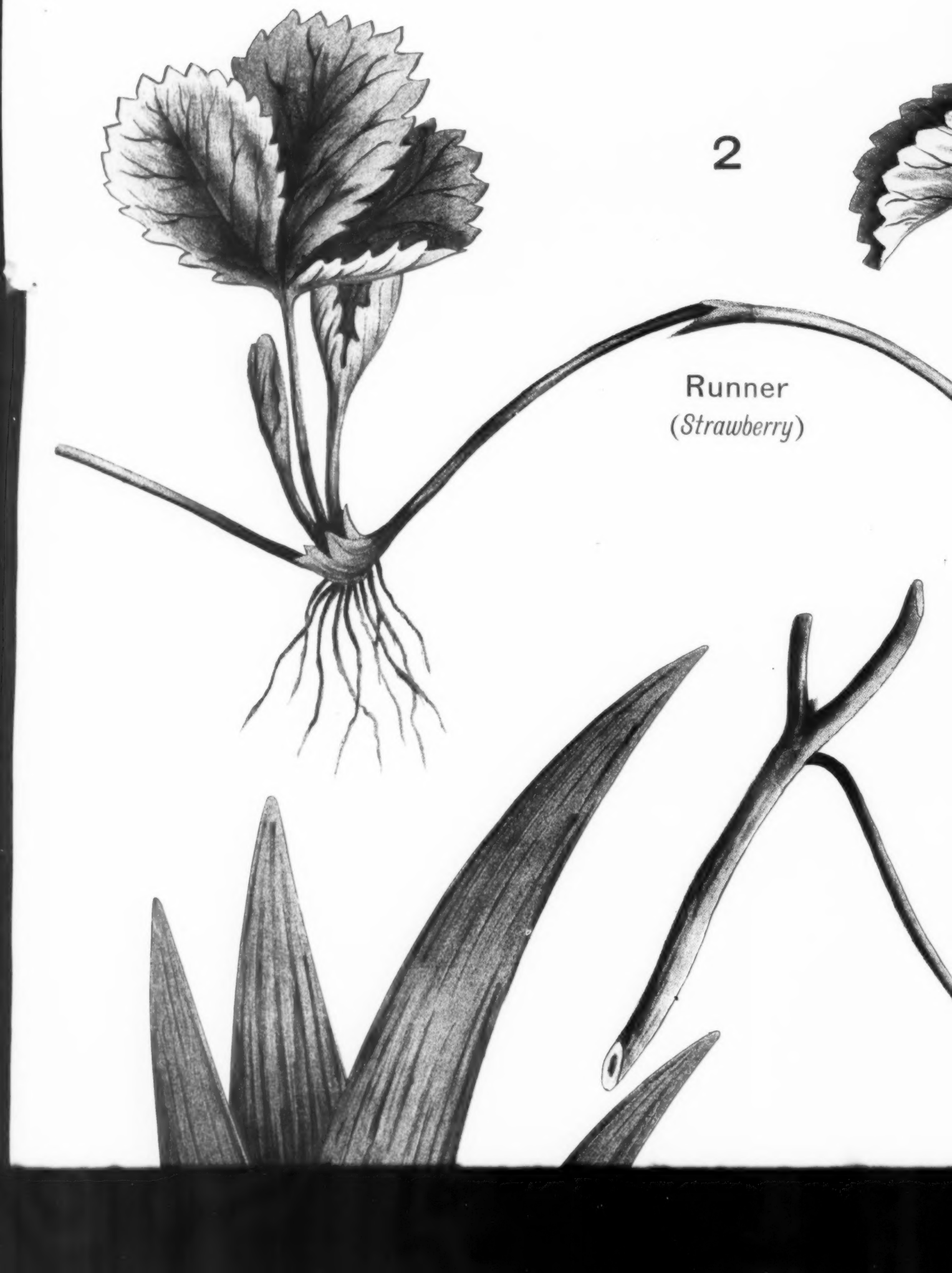

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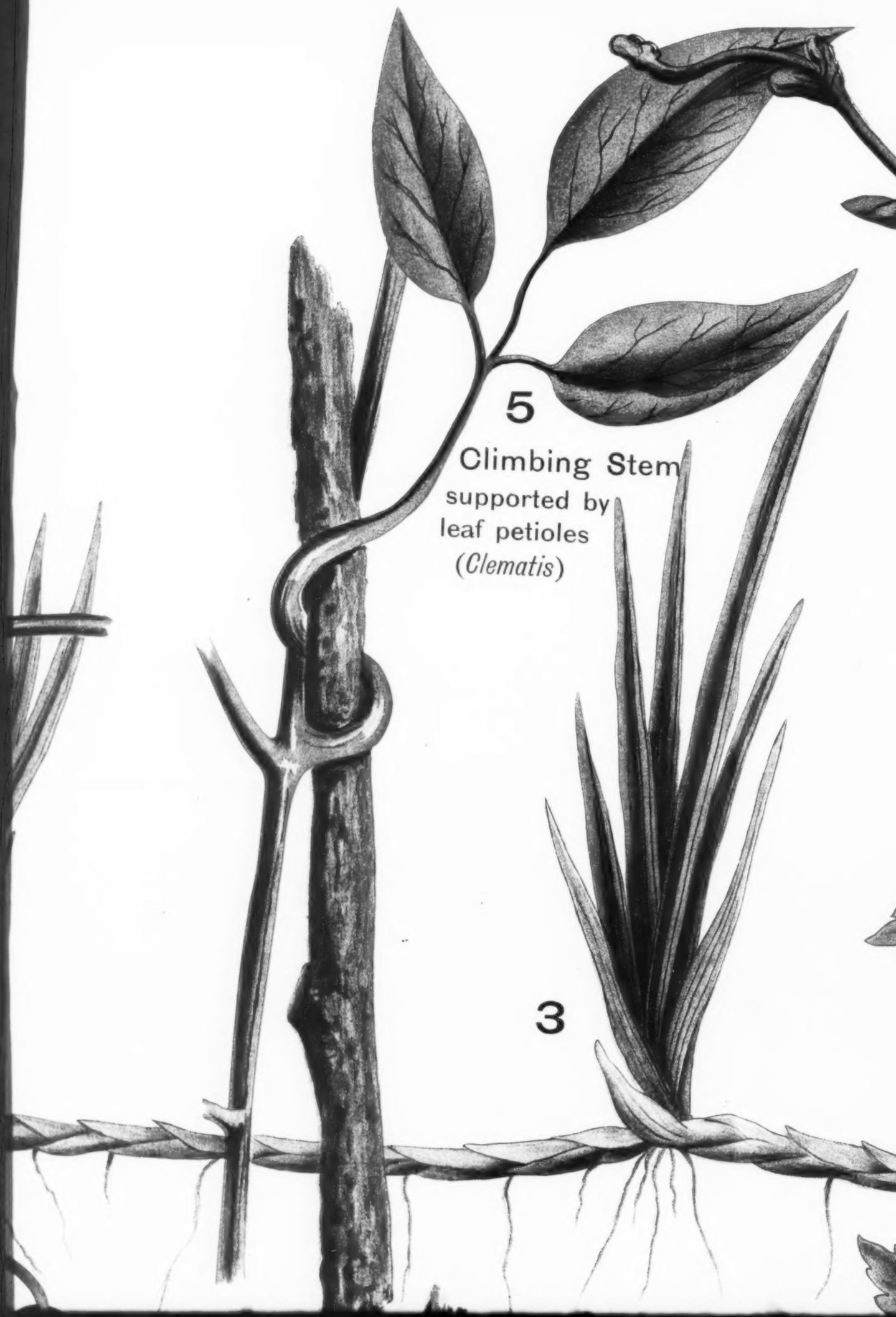

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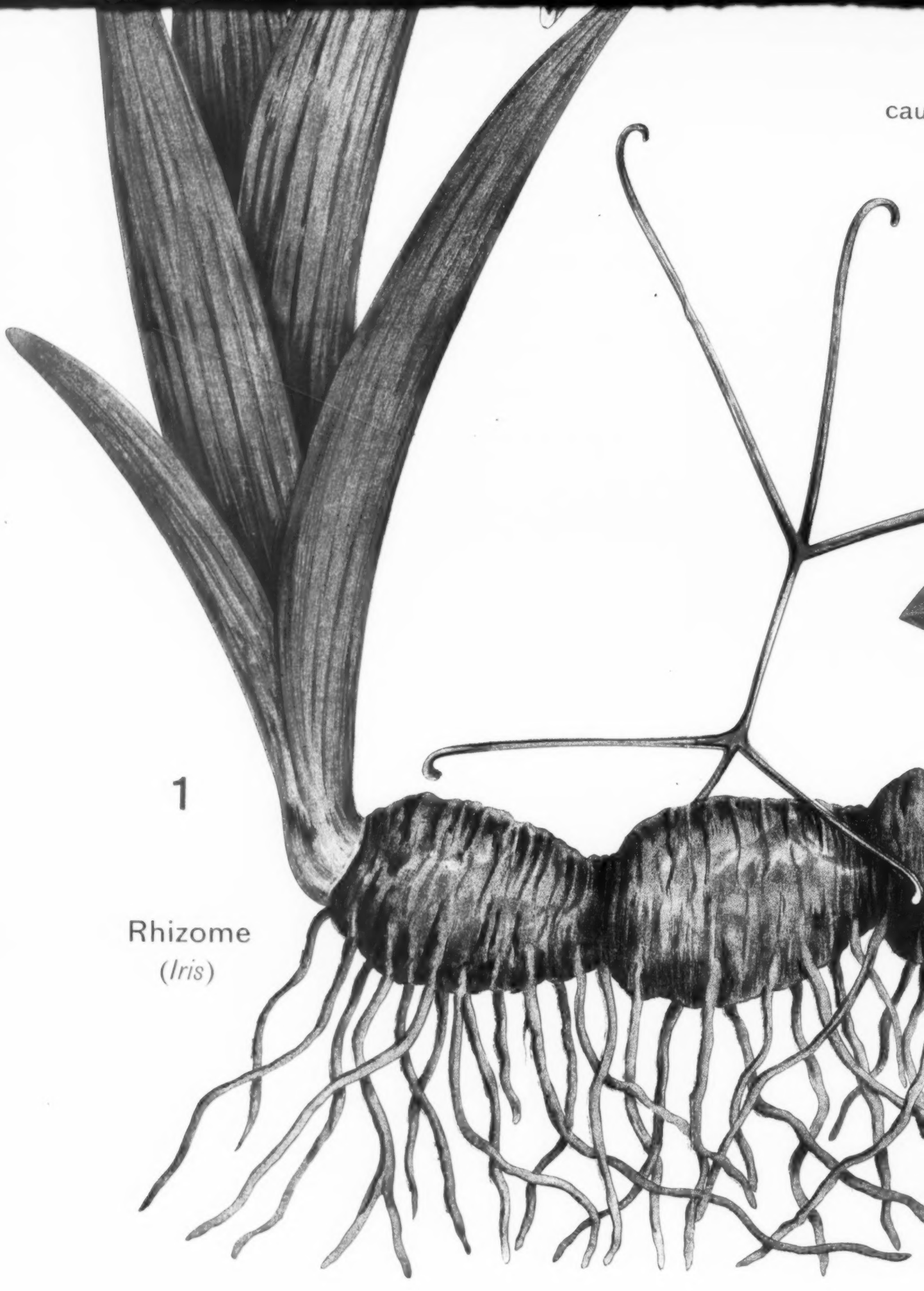

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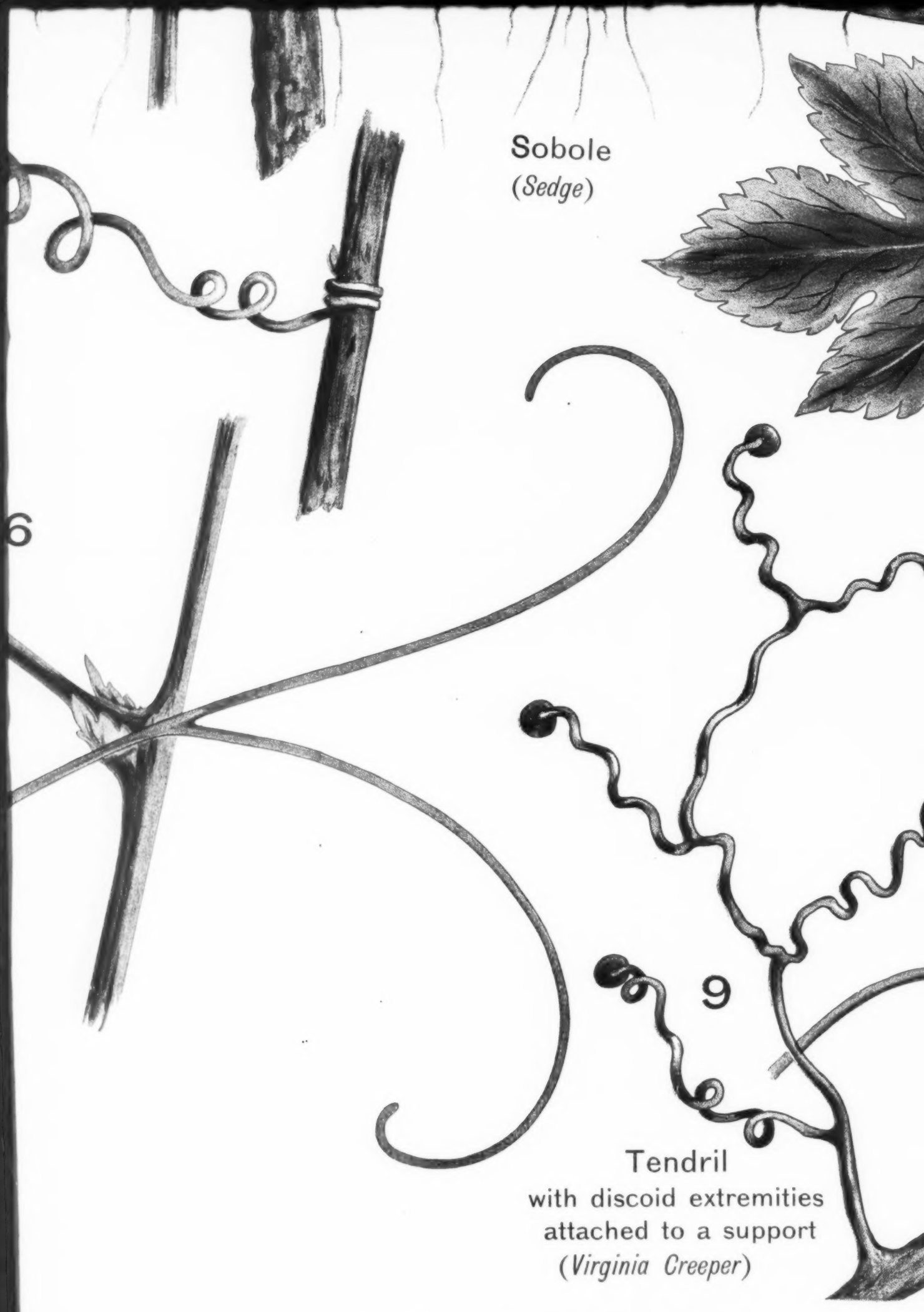

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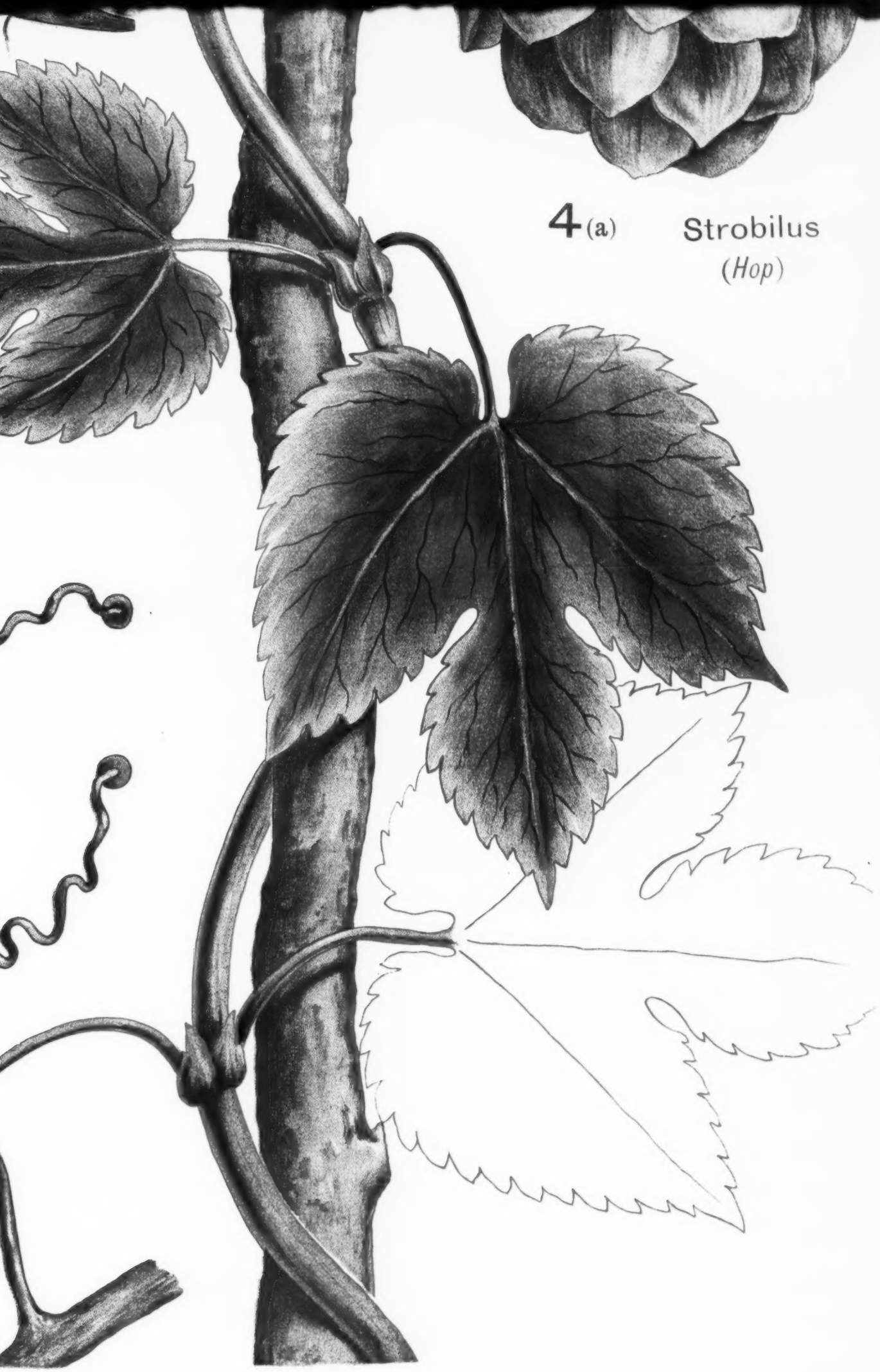

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